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GAS AND ELECTRIC LIGHTING.

A valuable report which makes a satisfactory comparison between gas and electric lighting has been made by Mr. S. L. Pearce, chief electrical engineer of the Manchester (England) corporation. To American engineers this report loses something of its value, since the costs are for English conditions, and can not, therefore, be applied indiscriminately in this country. But it shows what can be done under the conditions existing in Manchester, and it demonstrates the superiority of electricity there. In preparing this report a photometric survey of the streets lighted by the different systems is made, and the result is reduced to the cost of furnishing 1,000 candle-power for 4,000 hours. The operating cost for gas is at the rate of 2.16 cents per 1,000 candle-power, bringing the cost of 1,000 candle-power for 4,000 hours up to $87.48. For electric lighting the number of kilowatt-hours required to furnish 1,000 candle-power for 4,000 hours is 2,800. The running and standing charges for furnishing this energy are said to be 1.9 cents, and the cost of furnishing the light electrically is $60.32. This figure includes ten per cent for depreciation, a similar allowance being made in the estimate for gas, and for the cost of trimming. These figures cover, of course, merely the operating expenses, no profit being allowed.

THE CONSULTING PROFESSOR.

The usual practice to-day at engineering schools is to require the teaching staff to give instruction in the scientific principles of engineering and to supplement this, so far as possible, with information on every-day practice. That such instruction can not be entirely satisfactory is generally recognized, and various methods have been tried with a view to improving it. For some time past it has been the custom in engineering colleges to secure practising engineers to deliver occasional lectures upon their own work. This method is excellent, but as it can not cover the whole ground it does not relieve the instructors themselves of the burden of teaching practice. Another plan is to allow the teacher to do outside work; but, while this is admirable, it is very apt to overload the teacher. Still another method is to allow the instructor to alternate his time in teaching and practice; teaching, say, for two years, and practising for the next two. It is too early to determine whether this method will be successful, as it is only being tried. We apprehend, however, that those brilliant young men who go out to practice and make a success of it will have little inclination to return to teaching, with its drudgery and its poor pay.

There is still another way which is to be tried and which promises good results. The Brooklyn Polytechnic Institute, upon the advice of Dr. Samuel Sheldon, who believes that it is the province of the instructor to teach the fundamental underlying science and principles only, will ask the teaching staff of the department of electrical engineering to devote its entire time to this work. The information concerning practice which it is desirable for the engineering student to acquire, will be imparted to him by series of lectures in different branches of the art, each series being delivered by a specialist in his own branch. These lecturers will be designated as consulting professors, and their advise will be available in planning for the general course and in laying out the laboratory work. It is thought that in this way the undesirable features of the other methods will be avoided. The student will be thoroughly trained in his principles, and such information as he is given in current practice will be reliable and not out of date and he will be brought into close contact with practising engineers.

It is to the credit of the Brooklyn Polytechnic Institute that it has arranged to have these lectures delivered at a time when they can be attended by outsiders; we anticipate that there will be many who will wish to do so. Every effort to put our technical schools in a position where they are unexcelled has the hearty support of every one interested in the engineering profession, and one which promises such excellent results will be watched with interest and sympathy, both by the teacher and the employer.

A NOTEWORTHY ADVANCE IN ELECTRIC LOCOMOTIVE DESIGN.

The large electric locomotive built for the New York Central & Hudson River Railroad by the General Electric Company and the American Locomotive Works, both of Schenectady, N. Y., which was exhibited last Saturday, embodies a number of changes from the lines of design which have heretofore been followed. Perhaps the most striking of these departures from previous practice is the method adopted to obtain mechanical simplicity. The problem of adapting an electric motor to driving a locomotive would at first seem simple, but when taken up in detail it is found that complications arise which add greatly to the difficulty of obtaining a thoroughly reliable and satisfactory solution.

Contrary to what had been expected in some quarters, the New York Central's traffic commission decided that direct currents should be used in operating the electric zone in the neighborhood of New York city. This decision does not in any way reflect upon the new alternating-current traction systems, but the most important requisite of the new electric system was that it should be absolutely reliable, and the engineers forming the commission decided that the reliability of the alternating-current system is as yet an unknown quantity, while, on the other hand, fifteen years' experience with direct-current traction has demonstrated the suitability of this system for railway work.

While this decision for direct currents eliminated problems which would have been introduced had it been decided to try the alternating system, it is not to be supposed that it would be easy to do the New York Central's work by merely building locomotives along old lines and equipping them with more powerful motors. The problem confronting the traffic commission was how to build enormous locomotives which would be capable of handling the heaviest express trains at high speeds, and, at the same time, of drawing lighter trains at the schedule speeds. There was no particular difficulty in providing for the suburban traffic; it will naturally be handled in comparatively light cars equipped with motors and controlled by the multiple unit system. Sufficient experience has been had in the operation of this system in running single cars or trains to assure its success. But the possibilities of the multiple unit system did not end here, for it offered a solution of the problem of handling efficiently trains varying in weight and running at different speeds, which must be drawn by locomotives. The method adopted was to decide upon a standard size of electric locomotive suitable for hauling the lighter trains. This will be controlled by the multiple unit system, and when heavier trains are to be drawn, or higher speeds must be made, two or more locomotives will be coupled together, the system of control making it easy to operate in this way any desirable number.

The multiple unit system has thus provided a method of handling different types of trains. The next question needing attention was to design a suitable locomotive. Heretofore this problem seems to have been approached from two sides: by those who designed a good motor and then obtained a suitable truck upon which to mount it, and by those who, having a satisfactory running gear, looked for a suitable motor for driving. In each case there were two distinct parts of the locomotive—the truck and the motors, each of which must be sacrificed somewhat in order that it might work in harmony with the other. In building the new locomotive the manufacturers have not followed either of these methods, but have endeavored to build at once an electric locomotive—that is to say, they did not seek to build a good locomotive truck driven by an electric motor, nor to build a good railway motor and mount this on a satisfactory truck. It seemed to the manufacturers that there was no good reason why the two elements should not be combined into one, and unnecessary parts eliminated. This has been done. The side frames of the truck must be of ample cross-section to withstand the enormous strains thrown upon them. At the same time, they provide ample paths for magnetic fluxes, making field yokes unnecessary. The truck frame thus becomes part of the magnetic field of the motors, and the pole-pieces are rigidly attached to it, making special methods of suspension unnecessary. In this construction the poles must necessarily take part in any motion of the truck with relation to the driving axle. There are then two methods of mounting the armature. This must be fixed either so as to retain a fixed position with regard to the poles, or it must be rigidly attached to the driving axle. It is hardly necessary to say that driving by means of gears was deemed inadvisable. The method of mounting the motor armature so as to retain a fixed position with regard to the poles was the one adopted for the Baltimore & Ohio locomotives, the armature being mounted upon a quill, through which the axle passes. The other method has been used in the new locomotive, the armature being mounted rigidly on the axle. This calls for relative motion between armature and pole-pieces, a condition which, so far as we know, has never been allowed before. This motion is provided for by an ample air-gap and by placing the pole-pieces in a horizontal plane with vertical faces, and by making the latter rather flat. A two-pole type of motor was essential for this plan, as only in this construction could the necessary movement of armature in the magnetic field be provided for without danger of mechanical contact or unbalancing the magnetic distribution. This plan simplifies very considerably the construction of the locomotive. It does away with all spring-suspension of the motor parts. The fields become an integral part of the truck, and the armature bears a similar relation to the driving shaft. Besides doing away with these undesirable complications, this construction simplifies the making of repairs, as it allows any or all of the armatures to be dropped out of place without disturbing any other part of the truck. In this respect the electric locomotive will have a decided advantage over the steam machine.

This method of mounting the electric parts without the use of spring-suspensions raises several questions: what will be the effect upon a roadbed of the heavy dead load on the driving axles? The designers of the locomotive do not anticipate any trouble from this source, because the dead weight on the axle is not much more than that on the axle of the steam locomotive,

and it is thought this will be more than compensated for by the absence of reciprocating parts. The armature, mounted in this way directly on the axle, will necessarily be subjected to more severe vibration. What effect this will have upon it can only be learned from experience, but as the roadbed over which the locomotives will run will be as fine as it can be made, no trouble from this source is feared. These two questions, however, can not be answered in an entirely satisfactory manner, except in the light of further experience.

The great questions confronting railway engineers to-day is, can the traffic of a trunk line be handled electrically? Would electric operation be more economical than steam operation, and what is to be gained by the substitution of electricity for steam? While that portion of the New York Central which will be operated electrically will be only thirty-four miles in length, the experience gained from it will go a long way toward answering these questions. That a trial is to be made so soon is not due to a wish on the part of the railroad company to know whether electrical operation is better than steam, but to a condition confronting a great many important railway terminals. Where a large city is entered by means of a tunnel, and where, at the same time, a large suburban traffic must be provided for, steam operation is at a disadvantage—first, on account of the danger of a smoke-filled tunnel; second, because a suburban traffic demands frequent, short trains.

We believe that every electrical engineer confidently expects that the New York Central equipment will prove entirely satisfactory. The ability of the members of the traffic commission, in fact, assures this, and we doubt if the most sceptical steam railroad man anticipates a failure. The effect of the success of this equipment from an operating standpoint will be far-reaching. It will show that there is no longer any necessity for running steam locomotives within city limits. It will probably mean it will not be long before all large municipalities will take steps toward excluding steam locomotives from their limits. Where entrance is made through a tunnel we may expect an early change to electric operation; and, conversely, electric operation will enable roads to enter cities which before were unattainable. In fact, the Pennsylvania Railroad has not waited for other roads to demonstrate the feasibility of electric operation, but is at the present time constructing an elaborate terminal for its system in New York city, entrance to be made by means of tunnels driven under the Hudson river, all trains being driven electrically. The next question confronting the trunk line engineer after adopting electric operation for the terminals will be, how far is it advisable to extend the electrical zone? And having a certain section of the road operated electrically, will it be advisable to continue the use of two systems? Conservative electrical engineers say that harm is done by advocating the electrification of trunk lines at this time as the steam roads are not yet ready for it. But what of the future? Electric traction has grown so rapidly since it was first shown to be successful that it would be rash to make predictions. At the present time, however, there does not seem to be any inclination to stop its progress.

ELECTRIC WATER POWER VERSUS COAL.

Falling water is slowly but surely displacing coal in power production. This is true not only as to electric lighting and small motors, but also as to electric railways and great manufacturing plants.

Already millions of tons of coal have been saved by the electric transmission of water power. As the more remote power sites are developed, and transmission systems multiply and extend, it seems possible that coal will be crowded more and more out of use until substantially the entire power of the world will be drawn from waterfalls.

By some this may be regarded as an extreme view, but facts are not wanting that make it at least tenable. Take for illustration Montreal, Buffalo and San Francisco, the three greatest centres of transmitted water power on this continent. With development of the waterfalls within easy reach little more than started, electric motors of more than twenty thousand horse-power capacity are now operated with transmitted energy in Montreal. During a single summer month of last year there were distributed in the last named city enough electric energy from water power to displace 7,813 tons of coal, at the rate of four pounds for each kilowatt-hour. Only a trifling part of the water at Niagara Falls has thus far been diverted for power purposes, and only a fraction of the power thus developed has been transmitted to Buffalo. Nevertheless the electric energy from the falls distributed in Buffalo during a single month of a recent year saved no less than 14,000 tons of coal on the basis of four pounds per kilowatt-hour. The figures for the exact amount of water power distributed in San Francisco are not at hand, but the plant at Electra whose lines enter the city has a capacity of not less than 10,000 horse-power. If the average use of the transmitted power in San Francisco amounts to the full capacity of the generating plant during only ten hours per day, the saving of coal throughout the year must reach 54,750 tons, on the basis of three pounds per horse-power-hour.

Numerous other cases might be cited of single cities that consume the energy of hydroelectric plants of several thousand horse-power capacity each, but one or two instances where the actual output of energy is known will suffice. Such a case exists in a city of medium size in the East, where the electric energy from water power distributed during the fiscal year ending in 1903, represented a saving of 14,760 tons of coal, on the basis of four pounds per kilowatt-hour.

These figures for coal displaced by transmitted water power are not very imposing as to any one place, but they must be multiplied by scores and even hundreds to obtain the total saving that is now being made in our coal supplies by utilization of distant, falling water. Of course no one uses electric water power for the sake of saving coal, however desirable that may be for future generations, and the conquest which the transmitted energy of water is making in the field of coal is due to the cheapness of the former.

The Ohio Society of Mechanical, Electrical and Steam Engineers.

The ninth annual meeting of the Ohio Society of Mechanical, Electrical and Steam Engineers was held on Friday and Saturday, November 18 and 19, 1904, at Canton, Ohio. The objects of this society are to promote the practice and theory of the economical operation and management of steam power plants and allied sciences connected with engineering, both in construction and operation.

The following programme was announced:

Friday, November 18—Business meeting of the council; business meeting of the society; secretary and treasurer's report; address by the president. The following papers were presented: "Some Facts and Features about Electric Meters," by H. C. Fashbaugh, superintendent, Columbiana Electric and Waterworks, Columbiana, Ohio; "Notes on Solenoid Electric Mechanical Governors as Applied to Turbines and Impact Wheels—a New Departure in Water-Wheel Governors," by Frank S. Replogle, manager, National Water-Wheel Governor Company, Akron, Ohio; "System for Daily Inventory of Plant Cost," by James L. Butler, chief draughtsman, Stirling Boiler Company, Barberton, Ohio; "Liquid Fuel and Oil Burners," by George G. Bennett, district examiner, Stationary Engineers, Cleveland, Ohio; "Heavy-Duty Engine Service in a Modern Steel Plant," by Arthur L. Strickland, assistant chief engineer, Bessemer plant, Republic Iron and Steel Company, Youngstown, Ohio; "Boilers and Furnaces," by W. C. McCracken, chief engineer, Ohio State University, Columbus, Ohio; "Notes on Boiler Tests," by J. E. Bell, mechanical engineer, Stirling Boiler Company, Barberton, Ohio; "Gas Engines in Power Plants," by William T. Magruder, professor of mechanical engineering, Ohio State University, Columbus, Ohio.

The meetings on Friday were divided into morning, afternoon and evening sessions.

Saturday, November 19—In the morning the engineers visited the plant of the Russell Engine Company at Massillon, Ohio. In the afternoon the following papers were read: "Electrically-Driven Chapman Valves," by Herbert E. Stone, mechanical engineer, Cambridge, Mass.; "The Modern Steam Fire Engine," by F. F. Loomis, mechanical engineer, Akron fire department, Akron, Ohio.

The reading of papers was followed by the annual election of officers.

The Brooklyn Polytechnic Institute.

It is announced that the following well-known electrical engineers have been retained as consulting professors for the department of electrical engineering at the Brooklyn Polytechnic Institute:

Dr. Louis Duncan, consulting engineer, and former electrical engineer of the Baltimore & Ohio Railroad Company, of the Baltimore Traction Syndicate, and of the Third Avenue Railroad Company, New York city, will act as consulting professor of electric traction. Dr. Duncan's pedagogical experience, formerly as organizer and head of the department of electrical engineering at Johns Hopkins University, and recently as reorganizer and head of the department of electrical engineering at the Massachusetts Institute of Technology, particularly fits him for this position.

Mr. W. S. Barstow, consulting engineer and former general manager of the Brooklyn Edison Company, has been retained as consulting professor of central station practice.

Mr. Thomas D. Lockwood, head of the patent and technical information bureau of the American Telephone and Telegraph Company, and advisory electrician for the Western Electric Company and for the Bell Telephone Company of Canada, will serve as consulting professor of telephony, telegraphy and patent practice.

Mr. Charles F. Scott, chief electrician of the Westinghouse Electric and Manufacturing Company, will be a member of the board of consulting professors of the department of electrical engineering, and will give instructions concerning engineering in a large electric company.

Dr. F. A. C. Perrine, former president of the Stanley Electric Manufacturing Company, and for some years professor of electrical engineering at the Leland Stanford, Jr., University, will serve in the capacity of consulting professor in long-distance power transmission. Dr. Perrine has had much experience in this field, from his connection as chief engineer with the Standard Electric Company, of California, which company operates the longest electric transmission lines in the world.

These gentlemen will each deliver a series of lectures pertaining to his particular line of work, and these lectures will be delivered at night, so that persons not otherwise connected with the institute, and who are engaged through the day, will be able to follow such courses as they desire. It is proposed to charge a small fee for the courses, and credit toward an engineering degree may be given to those who follow them. It is not the intention to have these courses interfere with the work of the teaching staff, but they will enable the latter to devote their entire time to teaching principles and to laboratory work.

Extensive Damage to Telephone and Telegraph Circuits from Big Storm.

Early in the week the entire eastern coast of the United States suffered from the effects of a wide storm area. On Sunday, November 13, following a heavy rain, New York city and the vicinity for a radius of many miles suffered first from a pelting downpour of rain, followed by hail and sleet. Because of the high wind which accompanied the rain and sleet, extensive damage was done to telegraphic and telephonic circuits all the way from Florida to northern New York. It was peculiar that breaks in all of the big communication lines occurred at the same points. This resulted in the cutting off of the South and West from New York and New England. The most extensive breaks occurred at the Cumberland gap, in Pennsylvania, between Philadelphia and Baltimore, and at a point south of Poughkeepsie, N. Y.

The Postal Telegraph-Cable Company suffered most severely, and for a short time, at least, it was almost impossible to find out just where the lines stopped and communication was possible again. It hardly ever becomes impossible to reach all important points by "routing," which means that communication is established in some roundabout connecting-up of circuits. In order to reach Chicago from New York it was necessary to send a cable despatch *via* Manila through the new Pacific cable. From the data received in answer to this message it was easy to locate the extent of the damage and to promptly send repair crews to the wrecked districts.

The Western Union Telegraph Company did not suffer so severely, although the storm did considerable damage to its poles and lines.

The long-distance lines of the American Telephone and Telegraph Company suffered to a considerable extent, but in many cases the company was able to give excellent service with very little delay. The local service of the New York Telephone Company and the New York & New Jersey Telephone Company suffered almost no interruption, as within a radius of thirty miles of New York the wires are almost entirely underground. In the borough of Manhattan, where the bulk of business is done, no delay was noticed at any point.

Modern High-Potential Switchboard Practice—III.

By Bertrand Perry Rowe.

(Conclusion.)

REFERENCE was made in the preceding pages to the St. Joseph & Elkhart power station in which the generator control apparatus was mounted on panels which were located below their respective instrument panels with a space between for observation. Fig. 22 shows a view taken in this station showing the small operating gallery and part of the generator oil circuit-breakers. The exciter switchboard and feeder panels just adjacent, can be seen at the rear of the gallery. The photograph shows the wiring exposed on the rear of the generator control switchboard, but an ornamental iron screen fits over the entire rear of the panels to hide the wiring and is here removed. Such a screen is usually provided with such installations. It will be seen that the generator instrument panels are supported on a truss framework and the control and instrument wires are carried down the columns that support the galleries and are carried across to the generator panels on the channel iron brace at the end of the gallery. In this station all of the control cables were lead covered and were run in an iron conduit embedded in the cement gallery floor.

On the gallery in the rear of the operating platform may be seen the generator oil circuit-breakers. The arrangement of apparatus in the galleries is like that shown in Fig. 6,[1] the generator oil circuit-breakers being connected to either of two sets of station bus-bars by means of interlocking cut-out switches acting as selector switches as described. These switches may be seen near the ceiling in the photograph. They are operated by means of a hook on the end of a pole. The interlocking bar, which is operated in the same manner, prevents the two sets of bus-bars being connected together. A double-throw switch would have accomplished the same purpose but would have been inconvenient for the connections that had to be made in the rear.

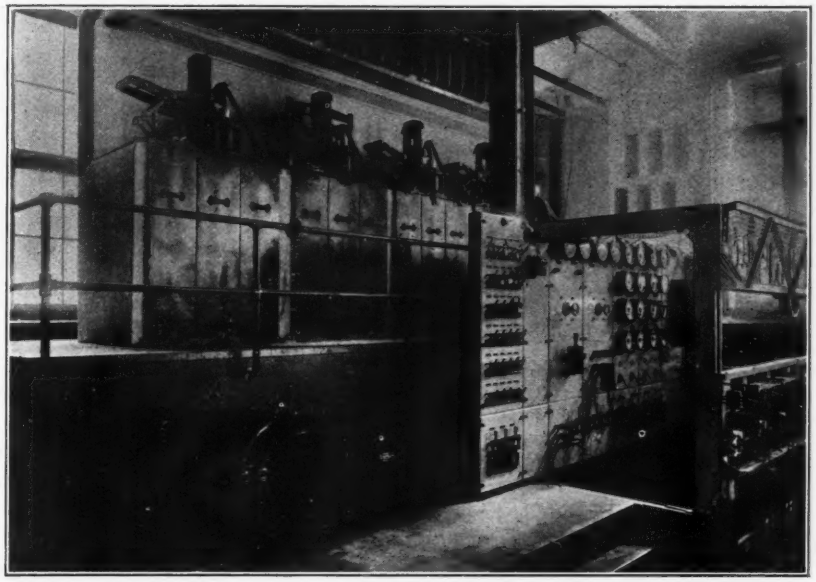


FIG. 22.—SECOND FLOOR, ST. JOSEPH & ELKHART POWER COMPANY, SWITCHBOARD GALLERY.

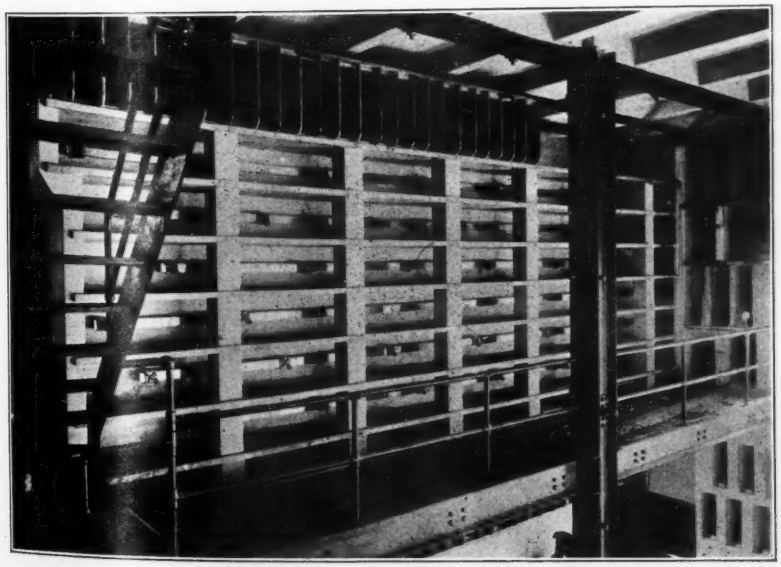


FIG. 23.—THIRD FLOOR, ST. JOSEPH & ELKHART POWER COMPANY, BUS-BAR STRUCTURE.

The cells in the concrete wall at the right of the picture contain the condensers for the static ground detectors.

Fig. 23 shows a front view of the bus-bar gallery. The concrete structural work may be seen supporting the soapstone shelves, as previously described, and the two sets of bare copper bus-bars are shown, supported on porcelain insulators. The selector switches for the feeder oil circuit-breaker are shown at the top of the structure and are similar in design and functions to those just described for the generator oil circuit-breakers. The bus-bars shown are in service, carrying current at 13,000 volts.

At the end of the gallery may be seen the enclosed cells with voltage transformers and their fuses, which operate the station instruments from the bus-bars. The soapstone doors, which usually cover both the cells and bus-bar structure at this point, are shown removed. The leads which connect to the station static ground detector condensers are connected to the transformer primary fuses which thus protect the condenser circuits as well as the transformers.

Fig. 24 shows the feeder oil circuit-breakers which are located in the gallery just over the bus-bar gallery. The bus-junction circuit-breaker, located on this floor, has its cut-out switches located in the rear similar to those shown in Fig. 1,[1] but on account of the connections to be

[1] ELECTRICAL REVIEW, October 29, 1904.

[1] ELECTRICAL REVIEW, October 29, 1904.

made and the interlocking features, the other cut-out switches were located in the gallery below.

Fig. 25 shows a view in the gallery above the feeder oil circuit-breakers, and the 13,000-volt feeder shunt transformers with their fuses may be seen in their cells. These operate the meters in the feeder circuits. The lightning arresters are also in this gallery and Fig. 26 shows a front view of these arresters. The soapstone cell construction may be observed here as well. It will be noted that each lightning arrester is provided with a knife cut-out switch.

The shunt transformers for the generator instruments and the static interrupters were located on the ground floor and just beneath the generator oil circuit-breakers.

It may be noted, therefore, that this installation is distributed over five floors or galleries, one above the other, which is a rather unusual case. The available space in the station was small and therefore the engineers of this plant were obliged to use the narrow galleries and economize space whenever they could.

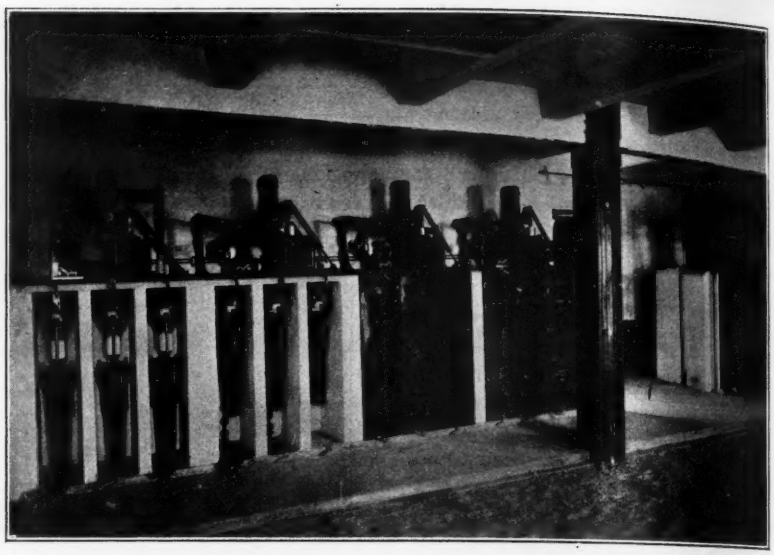


FIG. 24.—FOURTH FLOOR, ST. JOSEPH & ELKHART POWER COMPANY, SHOWING FEEDER OIL CIRCUIT-BREAKERS.

FIG. 25.—FIFTH FLOOR, ST. JOSEPH & ELKHART POWER COMPANY, SHOWING FEEDER SHUNT TRANSFORMER CELLS.

An example of a power station equipped with electrically operated oil circuit-breakers, controlling pedestals and instrument posts, is the new Pratt street power station of the United Railways and Electric Company, of Baltimore, Md.

The station accommodates six 2,000-kilowatts, 13,000-volt, three-phase generators and eleven outgoing feeders beside one circuit which supplies power to the motor-driven exciters. The station is unique in many ways.

The arrangement of the apparatus in the station, and many other novel features to be observed, are the work of Mr. P. O. Keilholtz, consulting engineer of the company. Referring to Fig. 27, a general view of the station may be seen, looking between the two rows of generators toward the operating gallery. It will be noticed that the oil circuit-breakers are located on the main station floor in the central space, in sections containing eighteen circuit-breakers to each section. There are three of these sections provided for, with passageways between each section. The third section is not yet installed. The entire electrical control is centralized in the gallery shown at the end of the station above the oil circuit-breakers. This gallery contains the generator control apparatus, the direct-current exciter switchboard panels, and the control and instrument panels for the 13,000-volt feeder circuits.

Above the controlling gallery is another

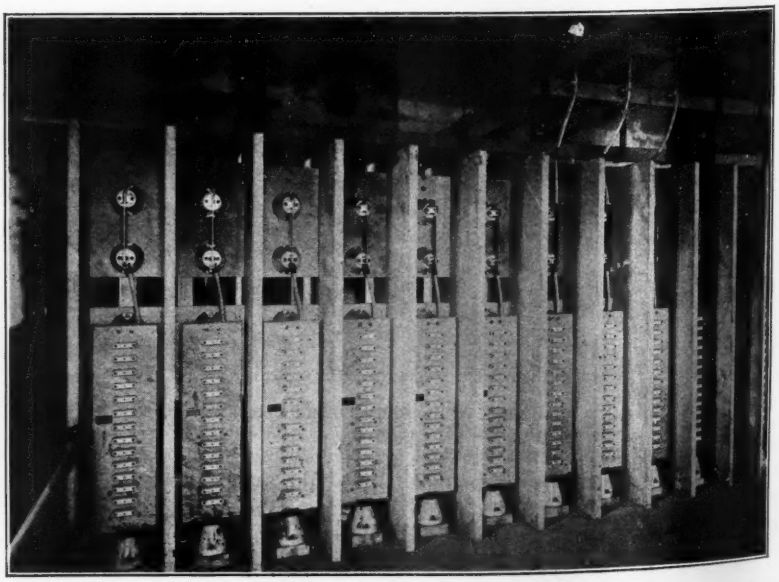


FIG. 26.—FIFTH FLOOR, ST. JOSEPH & ELKHART POWER COMPANY, SHOWING LIGHTNING ARRESTERS.

gallery on which are located the electrically operated field rheostats. The motor-operated face-plates are self-supporting and stand on the floor in front of their respective resistances.

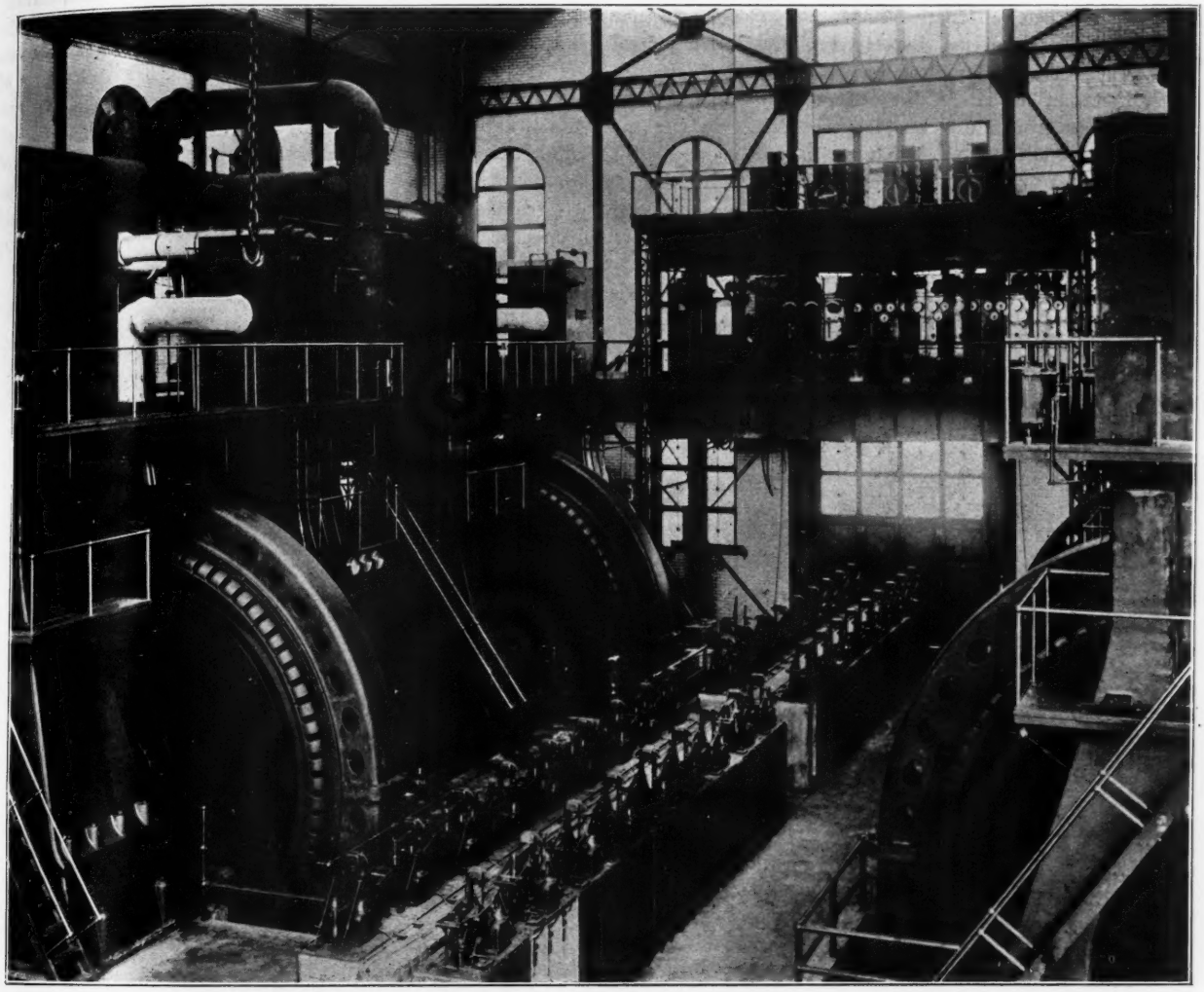


FIG. 27.—PRATT STREET POWER STATION, BALTIMORE, GENERAL VIEW OF EQUIPMENT.

Fig. 28 shows a better view of the controlling gallery. It shows the generator instrument posts which form part of the hand-railing with a controlling pedestal opposite each and the exciter and alternating-current feeder switchboard in the rear. The arrangement is similar to that shown in Fig. 17,[1] except that the station instrument post is not a part of the railing. The desk of the station operator is located here, and it may be seen that he has a commanding position from which he can view all of the apparatus under his control, and as he faces the station, in manipulating the control apparatus on his generator controlling pedestals, he is in a position to watch the operation of the apparatus and the signals of the engineer. The generator instrument posts are equipped with engine governor controllers, each of which controls the motor that moves the governor weights so that the operator controls the speed of the machines when synchronizing. The generator instrument posts are the same as shown in Fig. 16,[1] and the control pedestals are duplicates of the one shown in Fig. 15,[2] except that they each contain a hand-operated, field-knife switch instead of buttons to control one electrically operated.

FIG. 28.—PRATT STREET POWER STATION, BALTIMORE, CONTROL GALLERY, FRONT VIEW.

The station instrument post is a duplicate of the one shown in Fig. 18.[3] A closer view of this post, as well as the

[1] ELECTRICAL REVIEW, November 5, 1904

[1] ELECTRICAL REVIEW, November 5, 1904.
[2] ELECTRICAL REVIEW, November 5, 1904.
[3] ELECTRICAL REVIEW, November 5, 1904.

panel switchboard in the rear of it, is shown in Fig. 29.

The post contains a direct-current voltmeter connected to the direct-current exciter bus-bars, two alternating-current station voltmeters connected respectively to the two sets of alternating-current 13,000-volt station bus-bars, a third alternating voltmeter which can be plugged to any one of the alternating-current generators by means of the receptacles on the control pedestals, and a three-phase synchroscope. The post swivels so that it can be turned about to suit the convenience of the operator.

The illustration shows the exciter switchboard at the left which is only provided to take care of one pole of the circuit. The switchboard has a positive bus-bar which is fed from the exciters, the instruments shown being in the positive circuits. The exciters are compound-wound and the series coils are on the negative side of the machines. A negative and an equalizer switch are mounted on the frame of each exciter and the equalizer and negative connections are made beneath the station floor, as short and direct as possible.

The panels shown on the right of the illustration control the 13,000-volt feeder circuits.

The control and instrument leads for this gallery are taken down inside the built columns that support the gallery and are carried beneath the station floor to their respective instrument transformers and oil circuit-breakers.

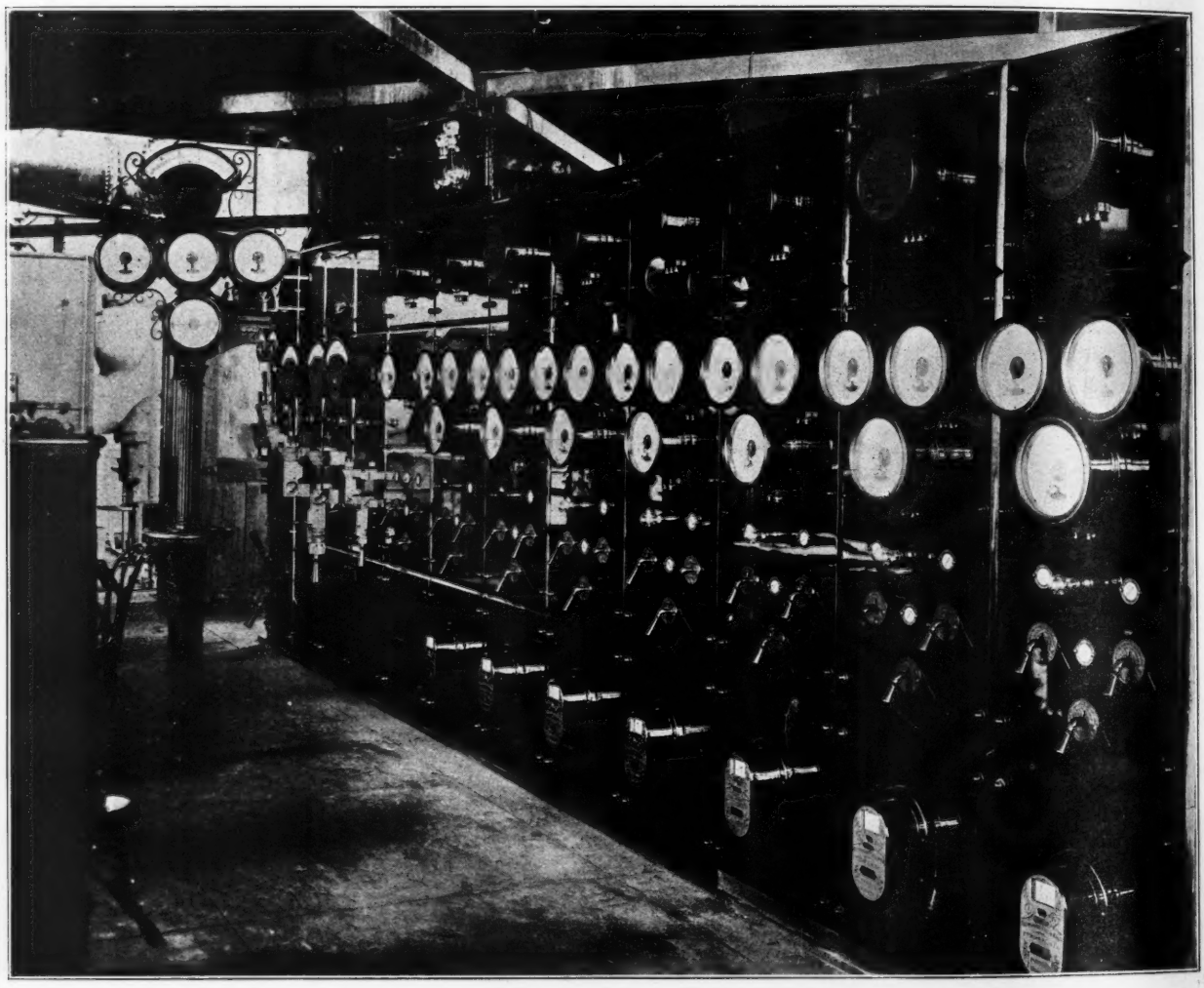


FIG. 29.—PRATT STREET POWER STATION, BALTIMORE, CONTROL GALLERY, VIEW OF APPARATUS.

It will be seen that there is no high-potential current in the operating gallery and the attendant is so far from any circuit-breaker or other high-tension device that he is as nearly safe, whatever might happen, as one could expect to be.

Returning to the oil circuit-breakers, the arrangement of apparatus is very similar to that shown in Fig. 1,[1] except that the oil circuit-breakers are placed close together, back to back, without cut-out switches, and the leads run down to the bus-bars through cells constructed in the rear of the circuit-breakers. All of the high-tension fireproofed switchboard cables are separated by fireproof barriers, the compartments throughout for the circuit-breaker structures being made of concrete while the bus-bar structure is of brick. Each generator circuit has three Westinghouse type "C" 20,000-volt oil circuit-breakers, one being connected directly in the circuit next to the generator, and the other two being connected to the first one by means of short auxiliary bus-bars, and acting as selector switches, one being connected to each set of three-phase bus-bars. By this means, when a generator is connected up to one set of bus-bars, the main circuit-breaker and one of the two selector oil circuit-breakers are always in series, giving the operator a chance to open either if an accident should happen. The three circuit-breakers just described, for each generator are located side by side in the centre of the section shown in Fig. 27, the selector cir-

[1] ELECTRICAL REVIEW, October 29, 1904.

cuit-breakers being on each side of the main circuit-breaker. It will be seen that in each section there is a group of three circuit-breakers on each side of the generator circuit-breakers just described, at the ends of the sections. These are for control of the 13,000-volt feeder circuits, the central breaker of each group being an automatic time limit overload circuit-breaker in the main feeder circuit, and the other two being used as selector switches to connect the feeder to either of the two sets of bus-bars, the connections being made the same as for the generator selector oil circuit-breakers. Each selection of oil circuit-breakers thus provides for two generators and four high-tension feeders. No cut-out switches are used in connection with the oil circuit-breakers in this station, the feeder circuits to the substation being in duplicate so that one feeder can be shut down, if the switches need attention, without interrupting the service. The duplicate set of bus-bars enables the selector circuit-breakers to be disconnected from service when necessary.

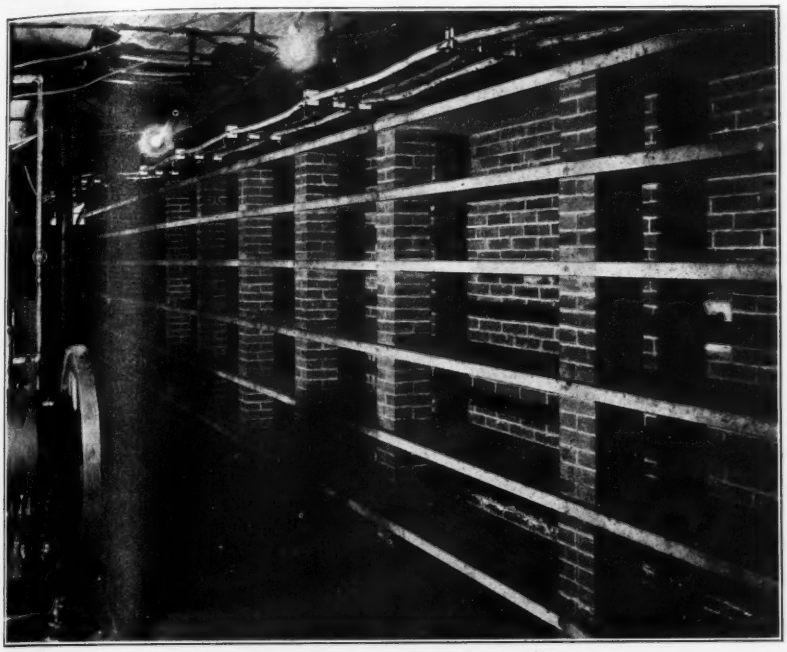


FIG. 30.—PRATT STREET POWER STATION, BALTIMORE, BUS-BAR STRUCTURE.

A view of one side of the brick bus-bar structure is shown in Fig. 30. This shows the main high-tension bus-bars in the three lower bus-bar compartments, the upper ones being used for auxiliary connecting bars to the selector circuit-breakers. Each side of the bus-bar structure is a duplicate of the other. The tunnel in the space between the sets of bus-bars, similar to that shown in Fig. 1,[1] is flanked on each side with compartments of brick in which the cables are carried, which connect to the bus-bars, and the voltage transformers and their fuses are located along the side walls of this tunnel. Some of the instrument current transformers are located here also and some of them are located on the cables leading to the high-tension feeder circuits, and shown bolted at the ceiling. The shelves of the bus-bar structure are of soapstone and the top shelf serves to carry control and instrument leads.

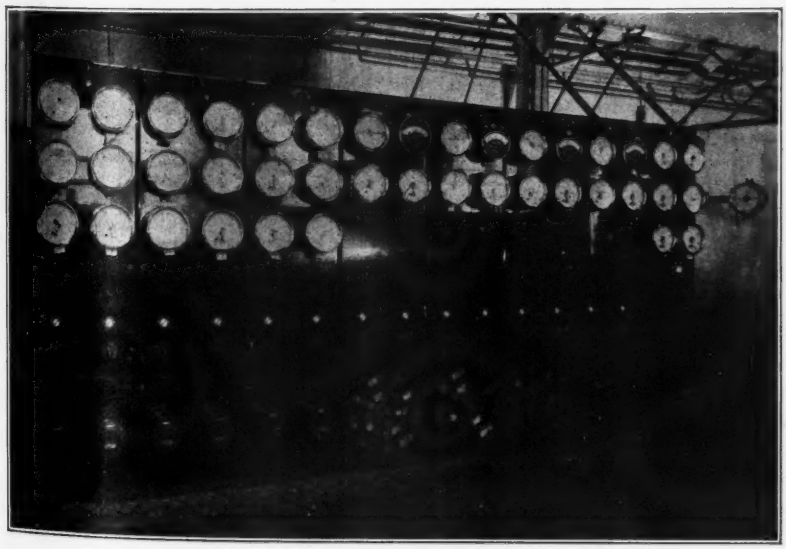


FIG. 31.—A TYPICAL CONVERTER SWITCHBOARD.

It will be interesting to note that the entire bus-bar structure and the bare 13,000-volt bus-bars shown, are located over six feet below the main tide level of the harbor. The power station is flanked by slips for vessels and a serious problem confronted Mr. Keilholtz when planning to keep the water out. The problem was solved by making a large sheet copper pan, perfectly water-tight, and bedding it into the floor and sidewalls of the concrete basement to a point well above the waterline. The heavy concrete on both sides of the sheet copper protects it from injury, while the copper prevents water from seeping through the concrete.

It is a notable fact that the station here described was so fireproof and the apparatus so non-inflammable and waterproof that during the recent great fire in Baltimore, no serious damage was done to the equipment, although the station was so hot that a human being could not stay in it and water flowed into the building and flooded the basement to within a few inches of the lowest 13,000-volt bus-bar. The station is in two parts separated by the boiler-house. The old portion was burned and the machines put out of service. After the fire the new machines were started up, current was put on the 13,000-volt bus-bars, and the station has been in operation ever since.

In conclusion it might be well to say something about the high-tension receiving stations or substations of such an installation.

The switchboard structures in these stations are usually built along the same lines as described for the generating stations, but the instruments and control apparatus are mounted on panels, although in some stations a simple form of controlling desk is used, as in some of the stations of the Manhattan Railway Company, of New York. It is obvious

[1] ELECTRICAL REVIEW, October 29, 1904.

that the apparatus is more simple and too much expense is usually avoided.

In rotary converter substations the most common arrangement used is to install two sets of switchboard panels, one set being used for the control of the current from the direct-current sides of the rotaries, and the other set for the alternating-current circuits. The instruments and oil circuit-breaker controllers are mounted directly on these panels. The two sets of panels are frequently separated for convenience in wiring.

The oil circuit-breakers are frequently located on the floor of the station and the bus-bar structure in a room below, making a double-deck structure. A single set of bus-bars is generally sufficient for small substations, although they are nearly always supplied from duplicate feeder lines.

In starting up such a station, no direct-current is available to operate the oil circuit-breakers. It is therefore necessary with the Westinghouse system to close the first oil circuit-breaker with a hand-closing lever supplied with each outfit. By this means the starting set may be put into service and direct-current obtained to operate the rest of the oil circuit-breakers. Where the rotary converters start from the alternating-current side the rotary converter must hither be driven by the starting motor and supply current to operate the oil circuit-breakers or else the first rotary has its coil circuit-breaker closed by hand.

Where storage batteries are installed in the substations, they can be relied upon when charged, to close the oil circuit-breakers in starting up the station.

Fig. 31 shows a front view of an alternating-current rotary converter switchboard which provides for the control of the incoming high-tension feeders, as well as the rotary converter. The rotary converters used in connection with this switchboard were started from the alternating-current side by means of the starting motor switches shown on the lower panels of the switchboard.

The switchboard used in connection with the direct-current side of rotary converters is practically a standard direct-current switchboard and is so familiar that any description is unnecessary.

It is perhaps well to explain that all of the illustrations and descriptions have been of three-phase apparatus, for the reason that the largest installation are usually three-phase. The same general practice is followed in all stations, however, whether single-phase, two-phase or three-phase. With the advent of the single-phase railway, we will undoubtedly see more of the two-phase power stations than we do at present.

Production of Aluminum and Bauxite in 1903.

A report upon the production of aluminum and bauxite in the United States during the year 1903 has been prepared for the United States Geological Survey by Mr. Joseph Struthers. It is impossible to obtain exact statistics of the production of aluminum because the Pittsburg Reduction Company—the sole producer in this country—deems it not advisable to state even approximately the output of its works. Mr. Struthers, however, estimates that the production during the year 1903 was 7,500,000 pounds, as compared with 7,300,000 pounds for the preceding year, and 7,150,000 for 1901. This estimate is based upon the fact that the use of the metal and its alloys has recently been extended, and bauxite—the crude material from which aluminum is extracted—has been consumed during the last few years in successively larger and larger quantities.

The report also deals with the uses of aluminum and its technology. The metal is used mainly for the transmission of electric currents in place of copper. A good proportion of the output is manufactured into articles for domestic and culinary use. It is being used more and more extensively for the construction of parts of machines and apparatus which require lightness rather than strength, and in the manufacture of special alloys; as a substitute for stone and zinc in lithographic work, and for the production of an intense heat in the thermit process. Aluminum is also being used in the manufacture of special explosives, and in various industries where it has taken the place of wood, such for instance as for lasts and boot-trees, for foundry patterns, and for bobbins for spinning and weaving machines. It is also used in the manufacture of metallic paints, for which purpose it is particularly suited.

Among the proposed new uses of this metal are its substitution for glass or earthenware in carboys employed for the transportation of nitric acid, and also as a substitute for zinc in lining systems for storing water.

The production of bauxite has increased owing to the development of this industry in Arkansas. The total quantity shipped last year was 48,087 long tons, valued at $171,306. The output in 1902 was 29,222 long tons. Georgia supplies the greatest amount of bauxite, followed by Alabama and Arkansas. The mineral occurs in other states, but the deposits are either not large enough or of sufficient purity to be of commercial value.

WIRELESS TELEGRAPHY ON MAIL STEAMERS.

BY EMILE GUARINI.

Since Marconi succeeded in sending messages across the Atlantic, the partisans of submarine cables have not been sparing in criticisms of wireless telegraphy—nearly all unjustified. These criticisms are merely card houses, and will collapse at the first breath. These persons have obstinately declared that it is not possible to maintain secrecy by syntonic work. The following account will show how this is now secured on the Belgian mail packets.

Syntonic operation is not the only solution of the difficult problem of secret communication without wires. The complete solution can only be secured by limiting the field of emission and reception of the waves. It may be said, in passing, that for about a year experiments looking to the last solution have given satisfactory results. By using several antennæ it has been possible to limit the electrical field, and it seems likely that the same limitation may be forced upon the magnetic field.

In fact, wireless telegraphy has been in Belgium, on the mail packets running between Ostend and Dover, England, thus demonstrating that radio-telegraphy has entered into a domain of current practice.

Tests with wireless telegraphy on the Belgium packets were commenced by Marconi in 1900. The coast station was established at La Panne, and provided with a mast forty-six metres high. The floating station was on the Princesse Clementine, which had a mast thirty metres high, twenty-six metres being the height from the transmitting coil. These two stations used a transmitter system consisting of an oscillator, one terminal of which was connected to the earth, and the other to an antenna. The tests were continued until October, 1901, and resulted satisfactorily. At each voyage the Princesse Clementine remained in communication with La Panne from the Ostend quay to the Dover pier. Storms, but not atmospheric electricity, exerted an unfavorable influence on the apparatus.

The Marconi system was then adopted by the Belgian government and installations were commenced in June, 1902. Communication by rail was very difficult to La Panne, and to ensure regular service the coast station was transferred to Nieuport Bains, the government owning land in that locality on which the station was erected. The city of Ostend

was not chosen for lack of a suitable site. The lighthouse might have been used as a station, but the city formed an obstacle which could not be neglected.

The new station was, therefore, established at Nieuport Bains, at the side of the signal station, near the west stockade. The building is of brick, to which is carried the terminal of the antenna. The mast, just as at La Panne, was erected in the immediate neighborhood. The station has telegraph communication with the interior of the country by ordinary methods. Then, in order to send a signal to sea, it is sent to the station by wire, and then retransmitted wirelessly. On the other hand, if a signal comes from a vessel it is received wirelessly, and transmitted by wire.

During the day, from 10 A. M. to 8 P. M., two government employés are on duty, thus ensuring communication with the steamers leaving Ostend at 10.37 A. M. and at 3 P. M., and with those leaving Dover at 12 o'clock noon, and at 4 P. M. The latter reaches Ostend at about 8 P. M.

Service during the night is maintained by an employé of the wireless telegraph company. He is on duty from 11 P. M. to 3 A. M., and establishes communication with the vessels leaving Ostend at 10.58 P. M., and Dover at 11 P. M. During each night voyage each of the vessels sends an average of three telegrams. During the day trips each vessel receives one telegram.

In general, the telegrams sent from the vessel first indicate the number of passengers and postal sacks, the direction and force of the wind, the condition of the sea and sky, the time of passing the lightship, and the number of revolutions of the propeller. Telegrams received on board are intended to ensure the satisfactory operation of the system. They consist of two lines of text from a book.

The following is the order of transmission for the vessels: first, the signal of a message, a number, then the number of words, the nature of the telegram (whether a service telegram, private or government), the name of the boat, and then the text, which might be as follows: "left Dover with full head of steam at 11.03 P. M.; thirty-two passengers; 270 postal sacks; cloudy; wind W. S. W.; heavy swell"; signature. If the telegram is sent during the voyage, the text would be about as follows: "passed Ruytingeu (the lightship) at 12.42 A. M., with 4,732 revolutions; all is well; the wind freshening; arrive probably at 2.50 A. M."; signature. The manipulation on the steamers is made by the commander and his officers, the employés of the telegraph company puting them in charge at that time. The stations on the steamers are syntonized—that is to say, they do not receive outside messages, and their messages do not interfere with other stations of Marconi apparatus having a different pitch. This syntonizing is required by the contract between the government and the company. With the ordinary system the Princesse Clementine and station at La Panne receive signals from all the English war vessels, and all the line stations from the other side of the strait—Dover, Trinton and North Foreland—receive them from La Panne and the Princesse Clementine. The apparatus on all the mail steamers and at the Nieuport station is identical.

The transmitting station consists of a storage battery of eight cells which supply the Ruhmkorff coil with eight amperes at sixteen volts, equivalent to 160 watts. The coil transforms the current to 40,000 volts. The storage battery is charged by the dynamo which lights the station. The antenna consists of three wires soldered together at the extremities. The total length of wire is 180 feet. The height varies on the packets from fifteen metres to twenty-seven metres, according to the height of mast.

The receiving apparatus consists of a receiver complete: relay, decoherer, coherer, jigger, box of batteries, next a Morse register and a signal bell. Each station is provided also with reserve apparatus, a storage battery, a coil complete, three Leyden jars, a receiver complete, and twelve batteries.

Until recently, the installation was reserved exclusively for the government service. One exception was made, on the packet which followed the regattas the service was public, the charge being one-half franc for fifteen words.

As has been said, communication was constant between Ostend and Dover and *vice versa*. It is said that neither wind, rain, snow, cold nor heat exerts any influence. Four or five messages are exchanged during each voyage. But as the communication is not made at any fixed hour, the station must always be ready for receiving from the departure until the arrival. When there are no telegrams to send, conventional calls and answers are made so as to assure that communication is not interrupted. The signals of the packets and of Nieuport only are received.

All the packets receive the signals sent to any one, but as each has its call letters, only the one interested answers. Signals are exchanged best during damp moonlight nights.

Since being established on the Belgian packets, the wireless telegraphic system has rendered some important services. One may be cited.

One day the packet encountered a Norwegian bark with a broken rudder and a leaking hull. A tug was despatched immediately from Ostend when the condition of the bark was reported.

During the Dover-Ostend regatta, a packet is put at the disposition of the guests and the jury. It serves at the same time to mark the finishing point and can not for this reason reach land before the passage of the last contestant. Before wireless telegraphy was employed, three hours passed before the results could be telegraphed to the papers. Now they are sent as they are made.

The author has been present during the sending of the despatches at regattas and it was noticed that with the ordinary system, that is to say without condensers, the transmission was much more rapid than when they were used. In the latter case the transmission was excessively slow. Further, one could hear and interpret the despatches even in the cabins. Moreover, it will be easy to obviate this inconvenience by suitably muffling the telegraphic cabin.

In case of dense fogs the packets ask each other what route each holds and if the siren can be heard. This condition occurred in the night of February 9-10, 1903, between the Leopold II and the Marie Henriette.

During the same night the Leopold II was grounded. By means of wireless telegraphy a tug was secured immediately and by disembarking the mail and passengers the latter did not even miss their train.

An incident of the same kind occurred two months later. A tug was called by wireless telegraphy to aid the Princess Henriette, which had broken a propeller.

When the light-buoy, marking the Ostend channel, accidentally went out the pilot warned the packet, which then took care not to miss the route. This happened in January, 1903. Should a packet be delayed the railway official is warned and he then takes the necessary measures.

One more fact before closing, which shows that the police may find the service of assistance. A robbery occurred in Brussels and it being thought that the thief might have taken the packet, the vessel was signaled by wireless telegraphy, and the commander made the search requested.

TELEPHONE ENGINEERING—XII.

BY J. C. KELSEY.

ORIGINAL FORTY-VOLT SYSTEM.

The third stage in the growth of the Stromberg-Carlson system reveals the elimination of the bridged primary, and the substitution of the bridged secondary for operating purposes. It also shows a gain of relay in the cord circuit which serves a double purpose. It causes both supervisory lamps to light simultaneously upon the entrance of the answering plug, and disassociates the busy testing devices during a connection. A condenser is also added to the cord circuit for purposes later explained. It will also be noted that single-potential lamps are used throughout the circuit, all forty volts.

The line circuit shown in Fig. 17 does not differ from the one shown in Fig. 16, and may be said to be the standard. The removal of the subscriber's receiver causes the line relay LR to be energized without affecting the differentially wound relay COR. The insertion of the answering plug extinguishes the line lamp LL, as the operation of COR opens the line relay circuit at *a*. Relay BR is the unbalancing factor, as it offers an additional current path which strengthens winding *y* and weakens winding Y, the relay armature being pulled up and removes winding Y from service, so that winding *y* can exert its fullest powers on its armature.

The insertion of the plug also causes relay BR to be actuated. This relay has a winding of 500 ohms, whose armature operates two make and one break contacts. The make contact *f* allows the lamps to receive their proper pressure through the back contacts of relays AR and CR. The other make contact *e* closes the talking circuit, while break contact *d* connects the busy testing devices to the cord circuit during its disuse. The battery circuit through BR when on connection is through its windings, contact *e* of the listening key, tip springs of jack and plug and the winding of cutoff relay COR.

The insertion of the plug extinguishes not only lamp LL, but the supervisory lamp AL, as the receiver is off the hook. The operator throws key LK and ascertains the desired number. With the key open she makes a test. At this point, the ingenuity of the inventor is seen. The opening of the listening key LK has opened the circuit of BR at contact *c*, and relay BR falls back to normal. If it did not then the operator could not make a test, as the contact *d* connects the busy testing device only in the normal position of the relay. At first sight it looks as if the answering plug cuts off the busy testing, connecting prematurely, but that difficulty is happily solved by the contact at *d*. When the test is completed, the operator releases the key and instantly BR operates, cutting off the now unnecessary testing devices. If the jack of the desired line is busy, the operator receives a click by reason of the protective potential existing on all the jacks flowing through the tip of the plug contact *d a* winding on the induction coil, thence to positive battery. The busy click is induced into the secondary circuit. As in all two-strand systems, it is necessary to protect the talking parties from interference during a test made on their lines. Therefore, to prevent the sudden lowering of the potential of the lines, it is necessary to place a high impedance in the circuit with the test in this case, possibly 3,000 ohms or more.

Finding the line idle, the operator inserts the calling plug. If the listening key is normal, the cutoff relay will be energized, and the circuit closed between the operator and the subscriber at the point *b*. She then proceeds to ring. The entrance of the plug has not caused CL, the calling lamp, to light, but it is a future factor in the proper operation of relay BR.

Being a two-strand system, the act of ringing will cause complication, unless temporary means are employed to hold the cutoff relay while the ringing key RK is engaged with the ringing generator terminals. Being thus engaged, it leaves the necessary balancing circuit open at *g*, and the cutoff relay would fall back to normal, and the circuit between the ringing key and the subscriber's bell would be open at *b*. The tip spring of the key engages negative battery, so that COR will be energized while the generator current passes out on the sleeve side of the line through contact *b*.

When the party answers, the relay CR is energized and lamp CL is extinguished. Should either party hang up receiver, the corresponding relay and lamp would signify. When both hang up, both lamps light and operator pulls down the connection.

If the operator should attempt to listen on a connection, the key LK would open the circuit between the two parties at contact *c*. To obviate this, the condenser K2 is placed to bridge the contact *c*. But this is not the primary reason, as operators are not supposed to break into conversations. The condenser is there to allow the operator to converse with parties through her calling plug—for instance, should the answering party be hung up. The operator could call a party by ringing, but she could not talk to him, or get the signal of his answer, unless she inserted the answering plug in a jack for an instant to give the relay BR a chance to lock itself through its own windings. When BR is once locked, the listening key can be opened at will and BR will not be affected. All in all, this circuit is a peculiar one, yet it is strictly correct, and very ingenious.

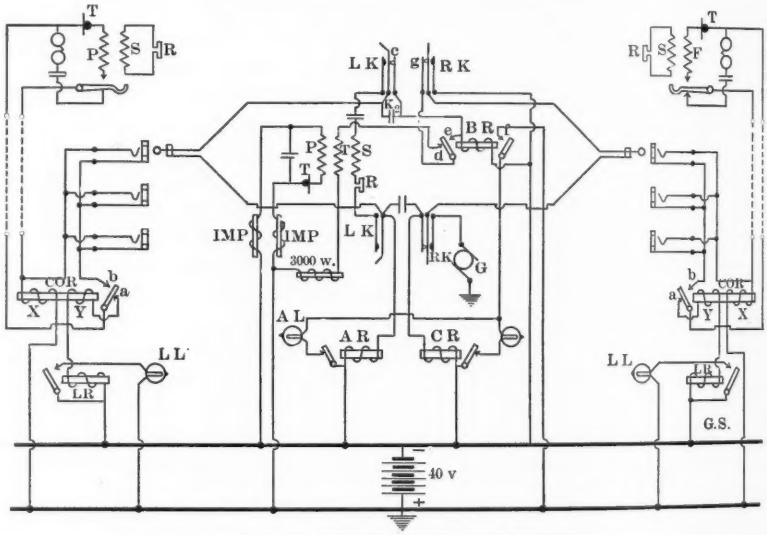


FIG. 17.—ORIGINAL FORTY-VOLT SYSTEM.

The new operator's set consists of the ordinary common battery devices, with one distinction, and that is the use of two impedance coils, one on each side of the battery, as seen in Fig. 17. The condenser seemingly separates the battery and impedances from the primary wind-

ing, and the transmitter, which in a strict electrical sense is correct, for the condenser really furnishes the impulses that actuate the transmitter.

The fourth stage shows no change in the line circuit and differential cutoff relay. The change is shown in the cord circuit, in which a fourth relay is added. The listening key has a pair of springs attached to one of its main springs, so that when the key is used the two insulated contacts are brought together. And in conjunction with the whole operator's position is operated a busy relay of a great number of turns and of high impedance to carefully safeguard the talking subscribers while a test is being made on their lines.

The line circuit in Fig. 19 is the same as Figs. 17 and 18. When the operator observes the line signal LL, she inserts plug and places the unbalancing relay UR in series with the cutoff relay COR. This upsets the balanced magnetic conditions, winding *y* overcomes winding Y, the armature is pulled up and winding Y removed from the circuit. Relay AR is brought into circuit when COR is actuated through contact *b* and is operated, preventing the lighting of the lamp AL. The battery circuit to the subscriber consists of relay AR, contact *b* lines, and winding *y* of COR. These are the impedances, which balance the circuit, individualize it, and prevent cross-talk between circuits. They are not in the talking circuit, properly speaking, but only in the path of talking current supply.

The operator throws listening key LK, bridging her set across the talking circuit. Finding the number desired, she tests in the usual manner. The tip of the calling plug comes into contact with a busy jack, and causes that potential to seek a ground through contact *g*, contact *h*, busy relay BR and ground. The relay is operated by the feeble current, but does not materially reduce the potential of the busy sleeve terminal. The operation of the relay causes a click to be given to the operator by current flowing through relay AR, contact *i*, receiver, induction coil, secondary and ground.

If line is not busy, she inserts the calling plug, which causes COR to be energized from the unbalancing effect of relay UR2, closing the circuit between the key-board and the subscriber. The ringing is done by generator current passing out through sleeve spring, contact *b*, over lines and back to battery and ground at the tip spring. When the party answers, relay CR is energized and calling lamp CL signifies it. When both parties hang up, both lamps light and operator pulls down connection.

There is the same little peculiarity that exists in stage 3. When the listening key is operated, the circuit between two subscribers is opened. This is prevented by extra contacts on relay UR2. Beginning at condenser 2, the circuit can be traced to the battery through relay UR2. Before the winding of UR2 is reached, a connection is made with a contact *d* normally open. The armature of relay UR2 is connected with the contact *g* on ringing key RK.

Now, suppose the listening key is open, contact *c* broken, relay UR2 still has a chance to be energized and locked through contact *d*, thence to contact *g* and COR. The same circuit that helps to lock the relay also furnishes a direct talking circuit around open contact *c*, so that at no time can a circuit between two subscribers become opened. Condensers K1 and K2 separate the functions of the answering and calling circuits, and serve to repeat the energy of one circuit to the other. This ever-ready device transmits faithfully the alternating fluctuations, and just as faithfully separates the direct-current functions.

This fourth stage represents the highest type of two-strand practice, and is as near perfection as is possible for common battery practice to claim. Hard service has demonstrated its wearing and serving strength.

The trunk circuit between exchanges of this system shows a distinct originality. While the trunk circuit consists

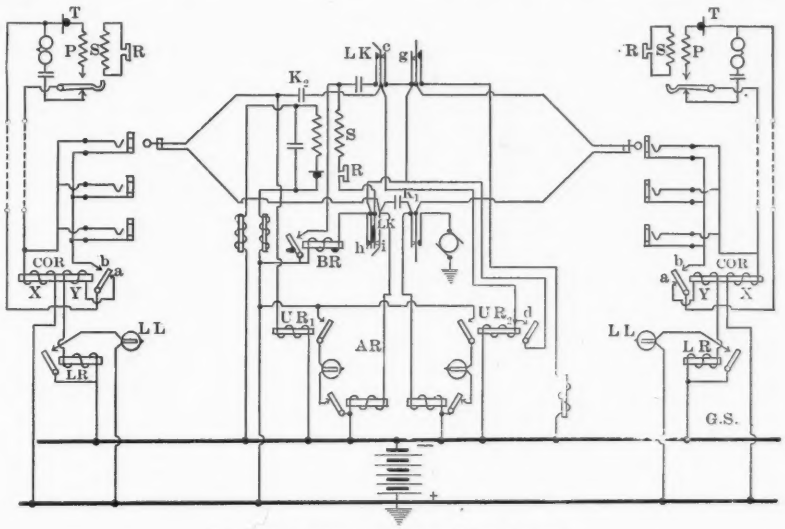


FIG. 18.—ORIGINAL FORTY-VOLT SYSTEM.

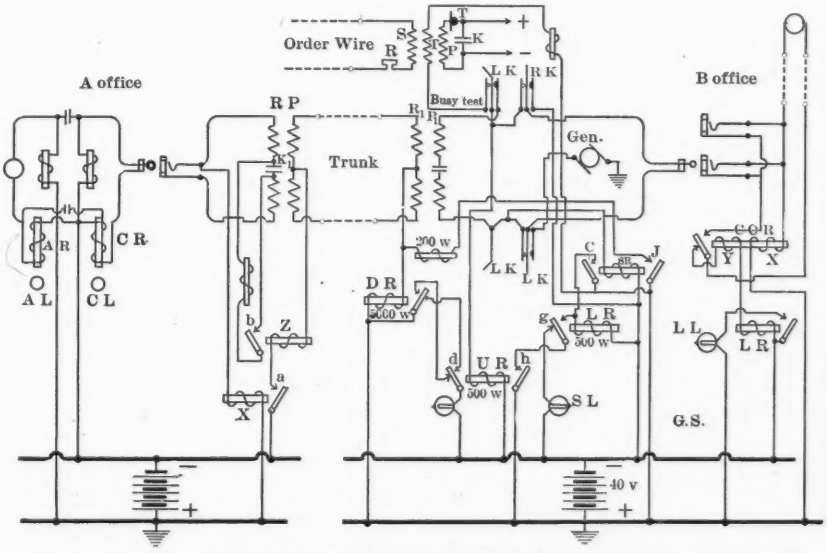


FIG. 19.—ORIGINAL FORTY-VOLT SYSTEM.

of the ever-essential, high-resistance relay bridged by the low-resistance coil during usage, the locking relay to prevent the B operator from being premature, and the ordinary cord relay to bring about the effects when the receiver is removed from the hook, an entirely novel feature is shown.

There are two repeating coils in the trunk circuit RP and R_1P_1, with the middle points of the line side of the coils brought out. With balanced copper circuits in most trying places, this trunk circuit comes very near to being absolutely noiseless. The exchange side of both coils are opened with condensers in order that signals shall be properly operated.

Suppose A party calling for B party; A presses order button and informs B operator. B assigns trunk and makes test with listening key. If not busy, she plugs into desired line. This lights both lamps DL and SL, as relay UR is operated in conjunction with the line cutoff relay. DL lights through made contact *d* of UR and normal back contact of DR. SL is lighted through back contact *g* of locking relay LR and made contact *h* of UR.

In the meantime, A inserts her plug, which lights lamp CL, and operates relay *y* at A. The operation of relay *y* closes contact *a*, and causes battery to flow through relay Z to the middle point of the repeating coil RP, thence over the trunk on both sides to middle point of R_1 P_1 to relay DR to ground.

The current flowing will not operate relay Z, because relay DR has a high resistance, 5,000 ohms minimum, and makes the amount of current necessarily small and too feeble to operate Z. But relay DR is operated, and its armature contacts are shifted, opening the circuit of lamp DL and extinguishing it. This tells B that the right trunk has been taken and she rings the party.

When the called party answers, the relay SR is operated. It has two effects: one on the A circuit, and one on the B circuit. The closing of contact *c* at SR puts a low resistance of 200 ohms in parallel with the DR with its 5,000 ohms resistance, and so materially reduces the circuit resistance that relay Z is energized. When relay Z attracts its armature, the contact *b* puts a low resistance about the condenser K^1, so that relay CR may be actuated, and the lamp CL extinguished. This notifies A of the satisfactory progress of her call, and leaves her free to attend other business. The contact J of SR at B closes a circuit through the relay LR and actuates it. When relay LR is actuated, the circuit of lamp SL is broken at *g* and goes out for the rest of the connection, for when contact *f* is made the relay is locked through its own winding, and will not be released until contact *h* is broken. SL simply tells B that the party has answered, and having nothing further to do, is put out of the way.

All four lamps are out when both parties are talking. When the calling party hangs up, a simple movement is made and AL lights. But when the called party at B hangs up, a greater movement takes place. In the first place, relay SR releases its armature. The low-resistance shunt is removed from the high-resistance circuit of DR, and relay Z at A becomes so weak that it releases its armature. Contact *b* open, relay CR is no longer energized and its armature releasement lights lamp CL.

Operator A, seeing both lamps, pulls down connections. Relay *y* is no longer energized, and releases its armature. Contact *a* is broken, battery circuit to relay DR at B is broken, so relay DR releases its armature and makes a circuit for lamp DL through contact *d* of UR and back contact of DR. This lighted lamp is B's disconnect signal DL and she pulls down the connection. Relay LR is unlocked and the circuit ready for another connection.

Unipolar X-Ray.

Samuel Stern, M. D., in the *Medical Record* describes a unipolar X-ray tube. He says that among the defects of Crookes vacuum tubes, as usually made, is the necessity of connecting both poles of the apparatus. This makes a tube which does not permit handling with any facility, and often prevents its use on surfaces that are not easily reached, such as those situated in various cavities of the body. Tubes usually have been made with projections from six to eight inches long, which brings the distance from the anode, where the rays are generated, to the top of the projection, where they are emitted, up to ten inches or more. These projections can seldom be passed directly to the lesion treated, and several inches additional distance must be allowed for. As the intensity of exposure is an inverse square ratio to the distance from the source of the ray, the exposures would have to be greatly prolonged in order to be effective. In treating lesions where the time of exposure is of great importance on account of the inconvenience of keeping the tube in position, this is a serious drawback. Also, the rays, as they are emitted from the cylinder, travel in all directions, and it is difficult to protect healthy surrounding tissue from their injurious effects.

Dr. Stern found that if two Leyden jars are so connected by their internal coatings to the two poles of a coil, and the external coatings are connected to a spiral coil having a few strands of thick wire, followed by spirals of fine wire, current which is derived from the inner extremity of the spiral, when connected with one pole of a Crookes vacuum tube, will produce X-rays. This method allows the use of vacuum tubes of different shapes and sizes, small enough to be passed into the throat or any other cavity, with the position of the cathode and anode arranged in such a way that the rays can be made to travel in any desired direction. Thus, if the larynx is under treatment the tube can be passed into the throat over the larynx, the rays being directed downward so that they will strike the larynx directly without being compelled to travel through intervening tissues. The fact that they are attached by only one pole, and that the bulbs can be made of any desired size, should make it a simple matter, according to Dr. Stern, to pass these tubes into the stomach.

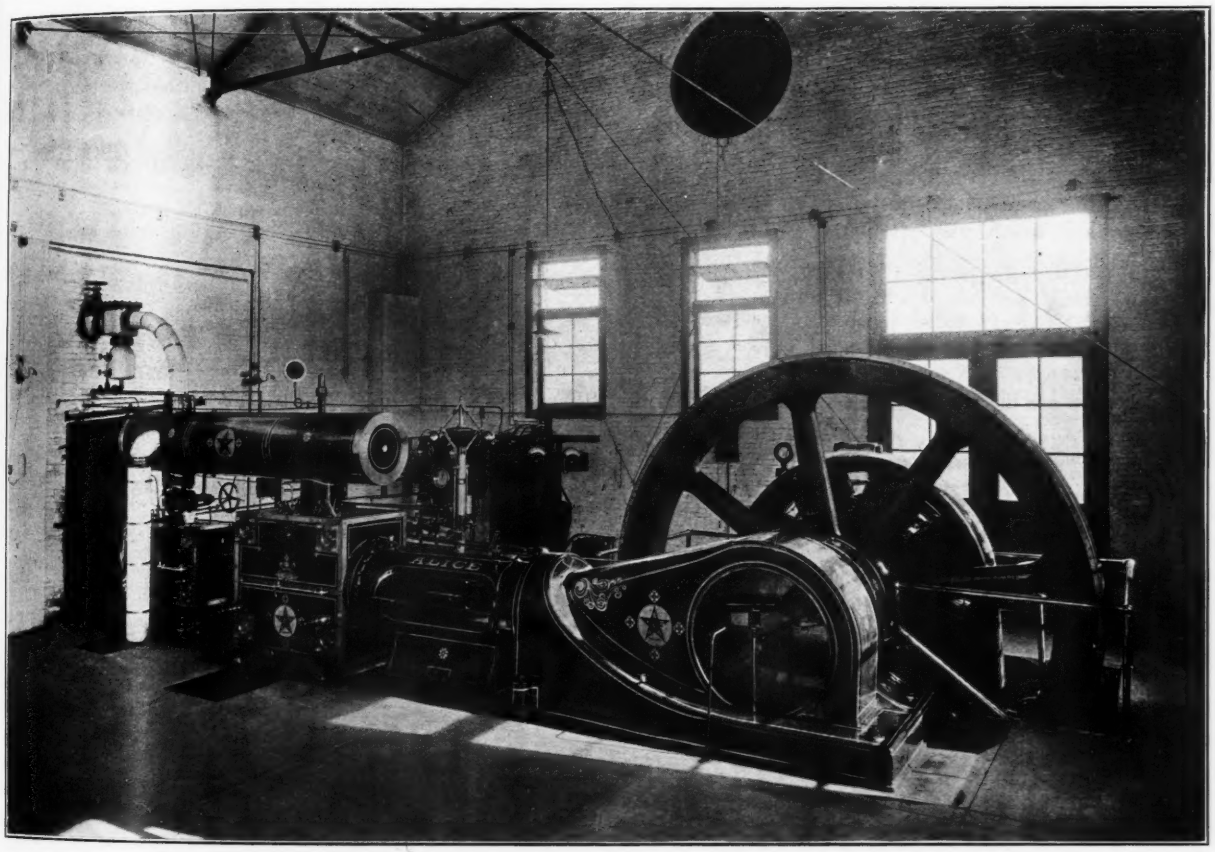
The tubes used by Dr. Stern are small vacuum bulbs with a cathode fused into one extremity and an anode into the other, placed at the usual angle. The cathode extremity of the tube is attached to an insulated glass vessel similar to those used in treating by high-frequency currents. This is screwed into a wooden handle with a wire running through it and inserted to the extremity of the cathode. The whole arrangement appears as an ordinary elongated high-frequency tube, with the exception of the unfused cathode and anode at its extremity. The anode has no attachment on the outside of the tube, and is merely used to direct the rays toward the point desired. Experiments tend to show that the anode is superfluous, and that the rays can be generated directly on the glass. These bulbs become hot in a short time, but as the source of the rays can be brought close to the lesions to be treated, half a minute's exposure at a distance of perhaps one inch from the source of the ray is equal to a number of minutes' exposure with the tube at the usual distance. There is some sparking from the surface of the tube, due to the high-frequency currents passing through it, which can be remedied by enclosing the entire tube in rubber, with the exception of the parts through which the rays are desired.

A Modern St. Louis Shoe Manufacturing Plant.

By William H. Bryan.

ST. LOUIS has come to be one of the largest shoe manufacturing and distributing centres of the United States. One of its largest manufacturing and jobbing houses—although one of the newest—is the Roberts Johnson & Rand Shoe Company. For some years this house has operated a plant at Hannibal, Mo., and about four years ago built another large factory at Thirteenth and Mullanphy streets, St. Louis. The exceedingly rapid growth of its business led the company to purchase, a year ago, a tract of land in the southern central part of the city, 738 feet long, east and west on Hickory street, and 278 feet wide, north and south on Mississippi avenue. This tract is known as the old Schneider's garden and for many years was used as a summer garden, the home of comic opera. The company purchased this property with a view of concentrating upon it, as soon as practicable, its entire manufacturing interests.

As the ground pitches downward to the north, it was decided to locate the power-house on the north line, as this would permit a gravity return-heating system, and the delivery of coal from an adjacent alley. It was also decided that the number of boiler and engine units in the power plant should be such that each would be of sufficient capacity to take care of the light, heat and power requirements of a single building. It was decided, furthermore, to proceed with the construction of the first building at once with an electric power plant sufficient for its own use.



ENGINE AND DYNAMO ROOM OF A MODERN ST. LOUIS SHOE MANUFACTURING PLANT.

The power and lighting requirements of this first building were mapped out as follows:

First floor, or sole leather room, one 15-horse-power, one 25-horse-power and one 50-horse-power motors; 259 16-candle-power lights. The large motor is belted to a dust-collecting fan.

Second floor, or finishing room, two 5-horse-power and four 10-horse-power motors; 241 16-candle-power lights.

Third floor, or making room, two 5-horse-power, one 10-horse-power, two 15-horse-power and one 20-horse-power motors; 245 16-candle-power lights.

Fourth floor, or fitting room, two 5-horse-power and two 7½-horse-power motors; 410 10-candle-power lights.

Fifth floor, or cutting room, one 5-horse-power motor; 280 16-candle-power lights.

Basement, one 40-horse-power motor for driving heating fan, and ten 16-candle-power lights.

Power-house, twenty-one 16-candle-power lights.

This made a total of twenty-one motors, aggregating 280 rated horse-power, and 1,466 incandescent lights. In addition there are two Otis electric freight elevators, each having a capacity of 3,200 pounds at 150 feet per minute. Each of these is driven by a direct-geared 15-horse-power motor. All machinery being located in a pent house directly over the elevators' shafts. The motors have full magnetic control. In determining the capacity of the plant these motors were considered, as their service is light and intermittent and for very short periods and is easily cared for by the overload capacity of the generator.

To determine the power-factor, tests

were made of the actual performance of similar motors at the Mullanphy street factory, where it was found that the actual maximum power requirements averaged a little under eighty per cent of the total rated capacity of the motors. Assuming this factor to apply also to the lighting, the maximum load requirements were found to be 320 electrical horse-power or 241 kilowatts. As the maximum requirements of the different machines would never occur together, and that the peak of the lighting load would exist for only a short period during the winter afternoons, it was decided that a unit of 200 kilowatts would answer every purpose. After an exhaustive study of the situation, it was decided to use the two-wire, 230-volt, direct-current system, the same as had been employed satisfactorily in the Mullanphy street factory. A contract for this generator at 100 revolutions per minute and the above-named motors—also to the low speed—was given the Westinghouse Electric and Manufacturing Company.

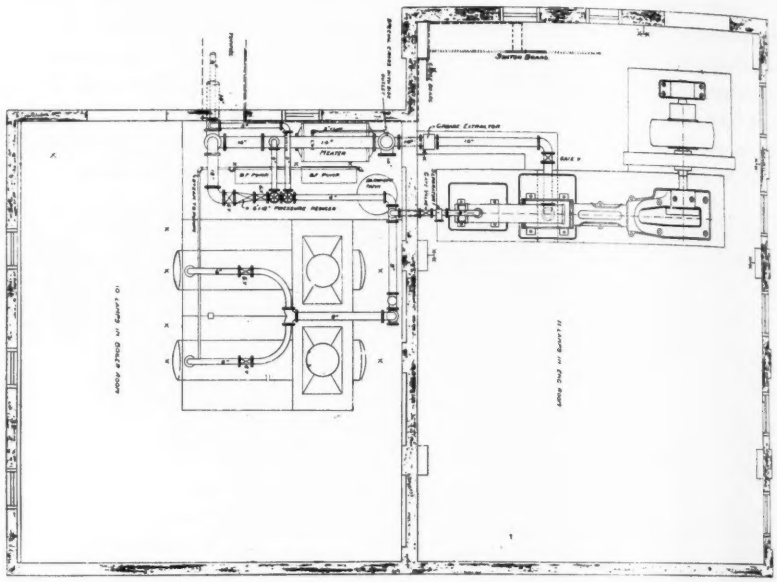
The switchboard is of polished black enameled slate, and consists of one generator panel and one feeder panel. On the former there are the usual field rheostat; one 1,000-ampere, triple-pole, knife switch; one 1,000-ampere, single-pole, I-T-E laminated circuit-breaker; one illuminated dial Weston ammeter, reading to 1,500; one illuminated dial Weston voltmeter, mounted on bracket at side of panel; also an eight-point voltmeter switch. The feeder panel contains one 1,000-ampere, double-pole knife switch for power circuit, one 400-ampere switch for lighting circuit and one 20-ampere switch for power-plant lamps. The temperature rise in all working conductors was limited to twenty degrees centigrade.

For driving the generator, a tandem-compound Corliss engine, built by the Fulton Iron Works, St. Louis, was selected, cylinders 15 and 26 inches by 36 inches, speed 100 revolutions per minute, rated horse-power 325. This engine was guaranteed to regulate within two per cent for all changes of load and steam pressure, and to deliver an indicated horse-power on twenty pounds of water, non-condensing; initial steam pressure, 125 pounds per square inch. The lubricating system, both for cylinders and bearings, is automatic throughout, from pumps and overhead gravity tanks.

After investigation and competitive bidding the Heine boiler rated at 238 horse-power was selected, and a reserve boiler unit was also installed to permit cleaning and repairs without interruption of the service. The boiler is set with the St. Louis form of down-draught furnace which has proved so successful in economizing fuel and preventing smoke. A guarantee of seventy per cent combined boiler and furnace efficiency was embodied in the contract. This figure, which corresponds to an equivalent evaporation of about eight pounds per pound of common Illinois coal, has been frequently reached, but can not be greatly exceeded under regular working conditions.

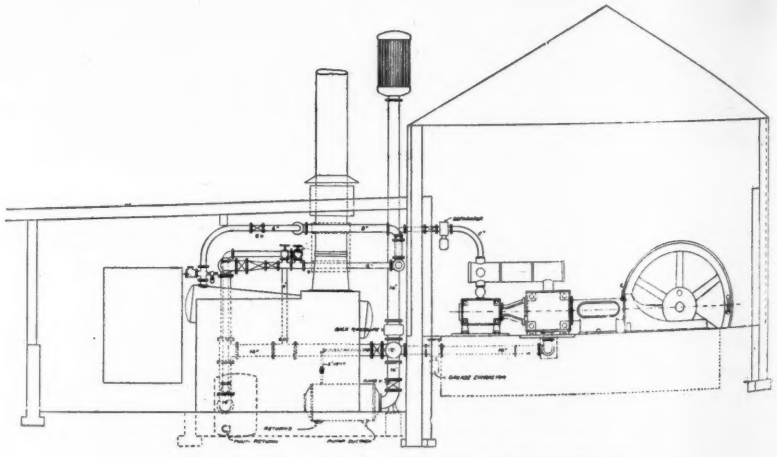
It was decided to defer the installation of a permanent brick or tile stack, and each boiler was provided with an independent sheet-steel chimney, 40 inches in diameter by 135 feet high above grates.

The general arrangement of the boiler and engine room is shown in Fig. 1. The topography of the land allowed the boiler-room floor to be located at a considerably lower level than the engine room, permitting a gravity return from the heating systems of all the buildings. Piers were provided in the engine room for a ten-ton electric-traveling crane which it is proposed to install later. Only one-half of the complete power-house was built.



FLOOR PLAN OF ST. LOUIS FACTORY POWER PLANT.

The arrangement of boiler and engine room presents no special or unusual features. The pipe connections involved a great deal of study and have been favorably commented on. A fourteen-inch "Economic" exhaust head condenses a large part of the exhaust and returns it to the 300-horse-power Hoppes feed-water heater, serving also as a receiver for the returns. Exhaust steam is used for the heating coils, supplemented automatic-

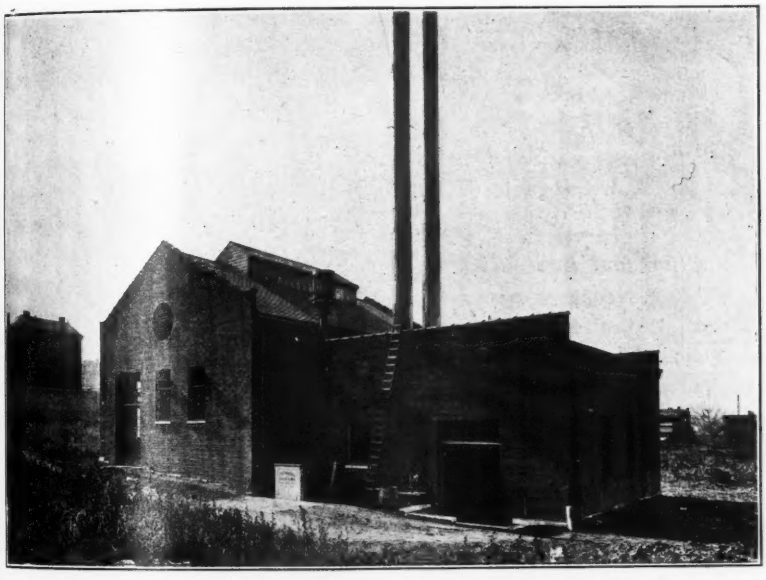


ELEVATION OF ST. LOUIS FACTORY POWER PLANT.

ally by live steam direct from the boilers through a reducing valve when necessary.

The gauge board, which is located in the northeast corner of the engine room, shown in one of the figures, is of black enameled slate to match the switchboard. On it are mounted one high-pressure steam gauge for boiler lines, one medium pressure gauge for engine receiver, one low-pressure steam gauge for heating system, one combination water-pressure gauge for city water supply and one eight-day marine clock. These are all ten-inch dial, nickel-plated.

A tunnel has been built for pipe lines and wires. Of the former there are three, one line carrying low-pressure steam for use in the heating system, another smaller line carrying high-pressure steam for use in the fan engine and in the shoe machines, and the third bringing back the returns from the heating coils. These lines are reduced in size at a point where a branch tunnel will be taken off later for the two additional buildings to be erected on the east half of the lot. No expansion joints were provided in the tunnel, the ninety-degree curves and the terminal connections being relied upon to take care of all movements.



EXTERIOR OF POWER PLANT OF A MODERN ST. LOUIS SHOE FACTORY.

A pair of 1,000,000-circular-mil rubber-covered cables carries the current for power from the switchboard through the tunnel and up to the top floor of the factory building. A pair of similar 400,000-circular-mil cables carries the current for lighting.

The heating system is located in a room under the first floor of the factory building. The heating is entirely by the indirect hot-blast system. The fan-wheel is ten feet in diameter, five feet wide, 150 revolutions per minute. It will deliver 60,000 cubic feet of free air per minute, sufficient for three changes per hour on the lower floors and five changes per hour on the top floors, the indoor temperature being maintained at seventy degrees, with zero degrees outside. The indirect coils consist of six divisions, each containing about 2,000 lineal feet of one-inch pipe, and each independently controlled. These are all located on the suction side of the fan. This latter is driven ordinarily by a belt from a forty-horse-power motor from a jack-shaft overhead, to which is also connected a steam engine intended for use at nights and on Sundays in very cold weather, and other times when the electrical plant may not be in operation. Provision is made for using indoor air through the fan by a trap door in the main floor, thus economizing fuel in extremely cold weather. The fan-wheel is located immediately alongside of and under the vertical brick flue which carries the heated air up through the building.

In general the motors are belted to short-line shafts from which the individual shoe machines are driven. This plan seemed to be a happy medium between the use of an individual motor for each machine, and of driving an entire floor—or half a floor—from a single motor.

Each motor has a No. 21 Cutler-Hammer starting box, provided with knife switch, fuses, overload and current indicators, magnetic release, mounted on a slate board.

The system of wiring in the factory building presents no particular novelties. As already explained, the two main feeders run from the basement to the top of the building on the north side of the brick hot-air flue. Junction boxes and cutout cabinets are placed at each floor, the latter containing the branch cutouts and switches from which the distributing circuits are run. The vertical cables are in iron-armored conduits. The cutout cabinets are of hardwood, lined with enameled slate, and provided with glass-paneled doors, locks and keys. In these cabinets are located the branch cutouts, switches and fuses on the slate tablet boards. Incandescent lamps are grouped in circuits of not exceeding ten lamps each. Each branch circuit has a General Electric double-pole plug cutout with cartridge fuses on the ceiling. Each lamp is suspended from a 230-volt fuseless ceiling rosette.

The factory has a maximum capacity of 8,000 pairs of completed shoes per day. The plant has now been in operation for some six months and has proved economical in fuel and satisfactory in performance in every way. Mr. Theo. C. Link, architect, of St. Louis, was in general charge of the installation, and with him was associated Mr. William H. Bryan, M. E., consulting engineer, in charge of the mechanical and electrical equipment.

Notes on Faults in Small Lead-Covered Wires.

A summary is given in the *Electrical Review* (London), for October 28, by Dr. Daniel Smeaton Munro of the dangers in the manufacture of small lead-covered cables, and the disadvantages of this type of conductor after erection. The dielectric is exposed to deterioration by heat during the process of covering, and there is a temptation to use an inferior insulating material, relying upon the protection of the lead. Broken strands in the conductor can not be detected by the tank test after the sheath is on. During erection careless workmen are apt to injure the insulation when removing the lead, and by overheating when burning or soldering at the joints. They are apt to overlook pin holes in the solder, which will allow moisture to enter. The lead is hardened by very little pulling, and frequently cracks. After the cable is up it is exposed to mechanical injury from nails and rats. The conductor can not be inspected, and when the lead expands with a temperature rise, being inelastic it does not return to its original length; consequently, conductors placed apart from each other may get into contact. The lead is more easily corroded than is generally assumed, even pure water having a solvent effect. Illustrations are given, showing a number of actual defects in such cables.

The Faraday Society.

At the meeting of the Faraday Society, the British electrochemical society, held October 25, several papers were presented, one by Dr. Henry J. S. Sand entitled: "The Measurement of the Potential of the Electrodes in Stationary Liquids; the Determination of Changes of Concentration at the Cathode During Electrolysis."

With a view to determine electrode potentials in solutions, the concentration of which in contact with the electrode should be known as accurately as possible, a method was elaborated for the measurement of potentials of electrodes in stationary liquids free from convection currents.

The apparatus employed was designed so as to allow the electrode to be placed accurately horizontally at the top or at the bottom, according as the electrolyte becomes lighter or heavier during electrolysis. The liquid connection to the normal electrode is tapped off about three to four millimetres in front of the electrode, the resistance between the junction and the electrode being found either by calculation or else directly by means of a Wheatstone-bridge arrangement for alternating currents, partly composed of condensers instead of resistances.

The method was checked by a series of experiments with a copper-sulphate solution, and gave satisfactory results for the diffusion coefficient of copper sulphate. The electrode potential of a silver solution showed irregularities which are undergoing further investigation.

When two reactions take place, the method may show their successive occurrence by a sharp break in the potential-time curve, analogous to Nernst and Glaser's breaks in their potential-current curves. An alcoholic solution of cuprous chloride which had become partially oxidized to cupric chloride showing such a break corresponding to the processes—reduction of cupric chloride and deposition of copper.

When acid solutions of nitrobenzine were electrolyzed the time-potential curves showed characteristic retrogressions of potential after a definite time, possibly corresponding to changes in the condition of the cathode.

From experiments on alkaline solutions of nitrobenzine a lower limit for the diffusion coefficient of nitrobenzine in the solutions experimented upon was calculated, and it was shown that Haber's results regarding the dependence of electropotential or current density can not be explained by concentration changes at the electrode.

Miss Buena Pool read a "Note on a Suggested New Source of Aluminum." The new source referred to in the title is India, thousands of square miles of the surface of which is covered with laterite deposits varying from a few feet to hundreds of feet in thickness. These laterites, of which four distinct classes are described in detail, are closely analogous to bauxite, the aluminum being present in the hydrated form. From specimen analyses which are quoted, it would appear that the high-level laterites in particular bear an obvious and striking resemblance to ordinary bauxite. The low-level laterites contain much free silica and clay. The conclusion of the paper is that these Indian bauxites have all the characteristics to render them commercially valuable; their pureness, ready accessibility, widespread occurrence at all elevations, and association with flowing water, pointing them out as an almost perfect source of aluminum.

Dr. F. Mollwo Perkin gave a short account of a paper by himself and Mr. H. D. Law, B.Sc., entitled "Electrolytic Oxidation of Hydrocarbons of the Benzine Series."

Radium and Radioactivity.

In a paper read at a meeting of the Ohio State Medical Association, at Cleveland, Ohio, May 20, 1904, Dr. Myron Metzenbaum presented the results of a number of experiments he had made on the radioactivity of different substances. He first reviews the work of different scientists on this subject and discusses the experiments of M. and Mme. Curie. His experiments follow the line of work suggested by Professor Becquerel, and consisted in exposing photographic plates, covered with black paper, to the action of rays from uranium salts, thorium, zirconium and other metals. He exposed the plates to the action of rays from the various materials placed at varying distances from the plate, and with the plate sometimes exposed directly and sometimes covered with black paper, and sometimes by placing the crystals on the reverse side of the photographic plate.

From fifteen typical experiments he concludes that the various salts of uranium are capable of affecting a photographic plate without the aid of direct sun rays. Also, that these rays can penetrate black paper, aluminum, bone and glass; and that they can act at a distance of several inches. He thinks that the radioactivity exhibited in the uranium products is due to minute quantities of radium contained in them.

From the experiments performed with thorium he reached practically the same conclusions.

He also experimented with zirconium and yttrium, which metals he says no other person had previously investigated. Regarding zirconium, he said it seemed to affect a photographic plate in less time than any preparation of thorium, and that it may be possible that zirconium shows more radioactivity than any substance except radium itself.

He also performed experiments with sealed tubes containing radium suspended in salt solutions, and solutions containing various drugs, to determine if these solutions became radioactive and would affect a photographic plate, and also to determine if they possessed therapeutic properties. A photographic plate was exposed to these solutions in some cases as long as twenty-one days, but in no case did they show the slightest effect on the plate.

When the supposed radioactive solutions were placed in aluminum boxes, and these boxes were placed directly on the film of a photographic plate, the plate was affected only at the points of contact with the box. The summary of the experiments showed that the action of the aluminum boxes on the photographic plates did not depend on the supposed radioactive solutions they contained, but that empty boxes and all sorts of aluminum articles, when placed in direct contact with the film of the plate, affected the plate at the points of contact in from 40 to 120 hours. Metallic aluminum had no effect on the photographic plate when it was separated from the film by paper or glass, or when placed on the reverse side of the plate. Dr. Metzenbaum concludes that the effect of aluminum on the plate was due solely to chemical action between the film and the aluminum.

Single-Phase, Alternating Currents to Be Tried on the Valtellina Railway.

It is announced in *L'Industrie Electrique* (Paris), for October 25, that the Finzi single-phase system will be tested in the near future on the Valtellina Railway, in Italy. A locomotive of the usual type has been equipped with the Finzi apparatus, and it will be employed in drawing a train of 100 tons at a speed of about forty-eight miles an hour. Each of the four axles of the locomotive will be driven through gears, by a single-phase, alternating-current motor rated at seventy-five kilowatts, and designed for from 200 to 400 volts. Current will be collected from an overhead line at 3,000 volts.

New Electrical Machinery at the Monterey County Gas and Electric Company.

The latest installation of electrical machinery at the Monterey County Gas and Electric Company, of Monterey, Cal., represents the newest products of the National Electric Company, Milwaukee, Wis.

This plant constituted the exhibit of the Kilbourne & Clark Company, Pacific Coast agents of the National Electric Company, at the eighth annual convention of the Pacific Coast Electric Transmission Association, held in Monterey in June last, and it proved of double interest to the members of the convention who inspected it because of the fact that it was shown, for the first time on the Pacific Coast, a type of machinery that had not been seen in operation theretofore, and because of its remarkably attractive and finely finished appearance, its well proportioned designs, its high efficiency, and in operation its remaining cool in all its parts despite the heavy duty imposed upon it. In detail, the machinery installed consists of a 200-kilowatt generator and motor-generator set, consisting of a synchronous revolving field motor, rated at 162 kilowatts, direct-coupled to a National 550-volt, 150-kilowatt, direct-current railway generator.

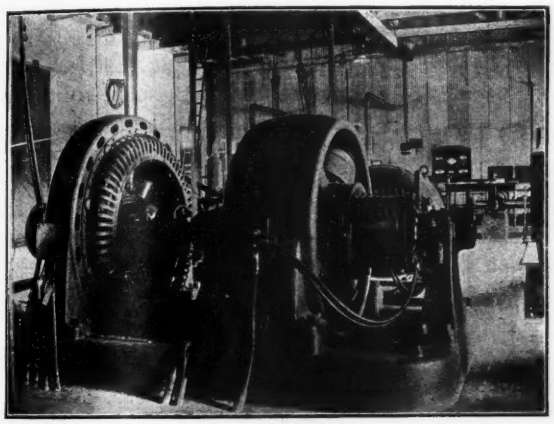
The 200-kilowatt alternating-current generator is of the belted type, with two bearings, pulley slide rails and belt-tightening device. It is of substantial construction, and follows very closely the structural design that has become well established in American types of revolving field generators. Its weight is 12,850 pounds, and its inherent regulation is within six per cent at unity power-factor. It is run at 600 revolutions per minute, and consequently to deliver a current at sixty cycles, is provided with twelve poles on its revolving field. The usual temperature guarantee, namely, that with an atmosphere temperature of twenty-five degrees centigrade, the temperature of the machine will not rise above thirty-five degrees centigrade under a continuous twenty-four-hour run at full normal load, was considerably bettered in that the actual rise under these load conditions was but twenty-two degrees centigrade above the temperature of the surrounding air. It has been found to stand a heavy overload without serious heating, and in regular service it has often been called upon to operate for considerable periods of time at an overload of over fifty per cent.

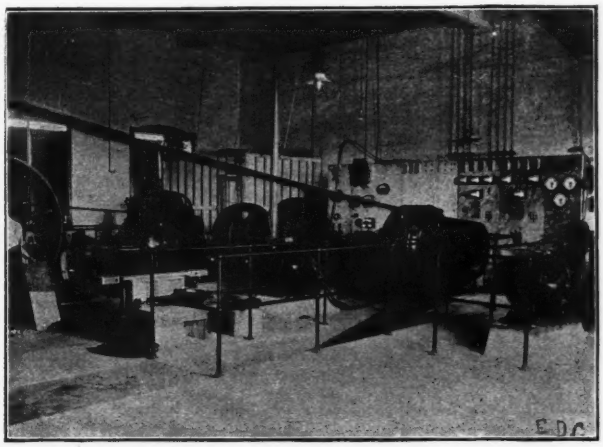
The efficiencies of the generator are as follows: 93 per cent at 25 per cent overload; 92.5 per cent at full load; 91.25 per cent at three-quarters load; and 88 per cent at half load.

The exciter runs at 1,450 revolutions per minute, is normally rated at twelve kilowatts, at 110 volts, and is belt-driven from a pulley placed on the end of the generator shaft. It, too, is cool in operation, and there are no evidences of sparking or flashing at the commutator, even under conditions of extreme overload.

The motor-generator set runs at 720 revolutions per minute. In operation the temperature of the synchronous motor and the direct-current generator does not exceed twenty-five degrees centigrade above the temperature of the surrounding air, when both machines are working under full load conditions.

An interesting feature in connection with the motor-generator set rests in the fact that a twenty-two-inch pulley with a sixteen-inch face has been placed on the shaft between the motor and the generator, and that this pulley is belted to the flywheel of a 200-horse-power high-speed Buckeye engine. This gives flexibility to the plant in that, during the hours of light load, both the units of the motor-generator set may be run as generators, and in that the motor-generator set affords the link by means of which the railway load may be coupled in with the two-phase load, or *vice versa*. This enables a day alternating-current service to be maintained in conjunction with the railway load, at maximum efficiency in operation. Though the installation of the motor-generator set may appear anomalous in view of the fact that the current for its operation is taken from generators located on the premises, it is in reality the rational solution of the problems presented by the local conditions which prevail.





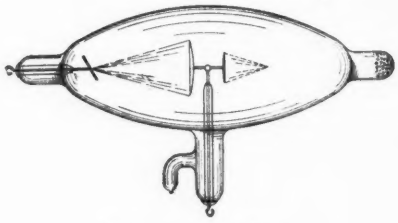
NEW ELECTRICAL MACHINERY AT THE MONTEREY COUNTY GAS AND ELECTRIC COMPANY.

The Hysteresis Loss at High Frequencies.

At a recent meeting of the French Academy of Sciences, MM. C. E. Guye and A. Schidlof presented a note upon the hysteresis loss in iron at high frequencies. This note covered an investigation conducted to determine whether the law recently proposed by M. Herzfeld was applicable to a wider range of values than had heretofore been demonstrated. In this law the hysteresis loss is given by the formula, $w = Af + Bf^2$, in which w is the loss in watts; A, the usual hysteretic constant; f, the frequency; B, a coefficient, which diminishes with the diameter of the wire under test. For wires less than 0.038 millimetre the coefficient B disappears. The new work was conducted on bundles of wires 0.06 millimetre in diameter, with frequencies varying from 300 to 1,200 cycles per second. The intensity of the magnetic field varied between 9.5 and 56.6 gausses. The results show that the law is strictly applicable to these conditions.

Electrical Patents.

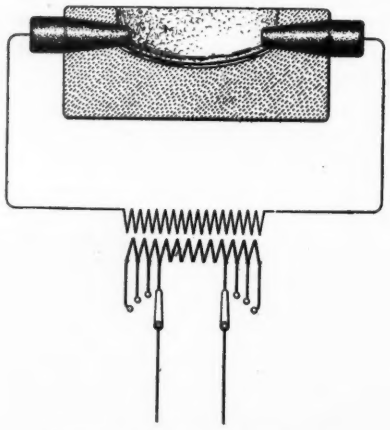
Elihu Thomson, of Swampscott, Mass., has assigned to the General Electric Company a patent (773,821, November 1) recently obtained by him on a Rœntgen-ray tube. The invention consists in a certain method designed to automatically maintain the vacuum in such tubes or other tubes at any desired point. It is well known that the constant use of any vacuum tube tends to gradually raise the vacuum to such a point that current can not readily pass through the tube. It is necessary, therefore, from time to time to artificially lower the vacuum in order to maintain the tube in operative condition. It has been proposed to attain this object by placing in the tube a chemical or other substance capable of giving off vapor when heated and applying heat to the chemical when the vacuum is to be lowered. The objection to this is that the regulation is not automatic, and very delicate manipulation is required to preserve the vacuum at the desired point. The methods hitherto proposed to render this action automatic all envolve the use of some extraneous regulating devices. The present



Rœntgen-Ray Tube.

invention is based upon the fact, experimentally discovered, that the cathode rays in a low vacuum reach a focus and are rapidly dissipated on passing such focus, while in a high vacuum they are turned into a jet beyond the focus and can pass over considerable distances without much scattering. Some vacuum-regulating device is therefore located at such a point with relation to a cathode that in a low vacuum it is not affected by the focalized rays to any material degree, but at such a point that when the vacuum rises the jet of rays beyond the focus will reach the material or regulating device and cause the vacuum to be slightly lowered.

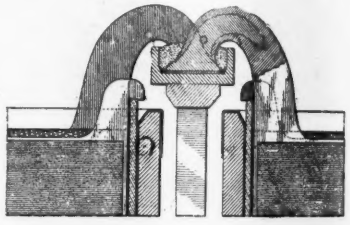
An invention relating to the art of electric heating and comprising novel means of producing and controlling temperatures within the range above the maximum temperature available by combustion and below that of the electric arc, has been devised and patented (773,821, November 1) by Charles P. Steinmetz, of Schenectady, N. Y., and assigned to the General Electric Company. In carrying out the invention, Mr. Steinmetz makes use of the fact that many refractory materials, such as refractory oxides, silicates, wolframates, chromates, etc., are of comparatively high resistances at ordinary temperatures,



Electric Heating Apparatus.

but increase in conductivity when heated, their conductivity increasing with the temperature. By exposing such conductors to a difference of potential and heating them to a suitable temperature, they become conducting, whereupon current commences to flow, giving rise to heat, the degree of which may be regulated or maintained at any desired point by correspondingly regulating the amount of energy expended in heating the conductor. The temperature at which these substances become conducting depends upon the substance, some requiring very high temperatures, as the pure oxides, while others, as the alkali silicates, become conducting at comparatively low temperatures. In making use of this feature for the purpose of electric heating, the substances to be heated are exposed, either directly or enclosed in a vessel of refractory material, to the heat generated in a mass of some chosen conductor.

Elmer A. Sperry, of Cleveland, Ohio, is the inventor of a storage battery (773,686, November 1) employing lead electrodes, and especially relating to the large batteries which are used in central stations. It is customary to support the electrodes of such batteries by lugs which project upwardly and outwardly from each electrode and rest on the upper edge of the containing-vessel or on vertical glass plates inside the opposite walls of the vessel. The weight of the large electrodes makes it necessary to provide containing-vessels of great strength. It is also customary to solder or burn the terminals of the electrodes of like sign in each battery to a current-main, the alternate electrodes of adjacent batteries being connected to the same main. These rigid connections make it difficult and expensive to remove any electrode for inspection or renewal. The present battery comprises a vessel and electrodes, each of which has at one end a lug carried by the vessel and at the other end a terminal which extends outwardly over the edge of the vessel and rests upon a separate support, thus relieving the vessel of one-half of the weight of the electrodes. Each terminal is preferably curved downwardly and provided with a flat face which rests upon and makes good electrical contact with a flat metal strip serving as a current-main. It has been found desirable to provide each lead terminal with an iron contact-piece having a shank which is cast into the lead and serves to stiffen it. The iron, having a higher specific electrical conductivity than the lead, decreases the resistance of the terminal and makes it possible to amalgamate with mercury both the surfaces of the



Storage Battery.

contact-pieces and the strip upon which they rest, thus reducing the resistance at this point to a negligible quantity. To project the iron contact-pieces and the strip upon which they rest from corrosion by acid fumes, the strip is preferably placed on the flat bottom of a non-conducting trough, and the space above the strip and between the terminals is filled with a seal of plastic insulating material. Each electrode may be provided near its middle with an upwardly projecting eye to receive a hook for lifting the electrode out of the cell, the eyes of the adjacent electrodes being out of alignment.

The mileage of telephone lines in Iowa increased from 14,043 miles in 1903 to 48,491 miles in 1904. In 1903 the mileage of telephone and telegraph lines in Iowa was valued at $7,797,487, and in 1904 at $8,808,126. The principal increase was in the rural lines, which explains the disproportionate increase in valuation.

The New York Central Electric Locomotives.

An Exhibition and Trial of the High-Speed Electric Locomotives Built for the New York Central & Hudson River Railroad Company by the General Electric Company, Schenectady, N. Y.

ON SATURDAY, November 12, a party of gentlemen representing the technical and daily press of New York city, by invitation of the New York Central & Hudson River Railroad Company, the General Electric Company, and the American Locomotive Company, went to Schenectady to witness an exhibition of the first electric locomotive built by the General Electric Company and the American Locomotive Company for the New York terminal of the New York Central. A private car was attached to the train leaving New York city at 8.45 A. M. in the morning. Luncheon was served during the trip. After reaching Schenectady about 12.30, a private car on the Schenectady Railway Company's line took the party out to the testing track where the locomotive was exhibited.

The party had been preceded by a special train from New York, carrying the New York Central railroad traffic commission, officials of the railroad and a large number of invited guests. This train consisted of nine Pullman cars, and after reaching Schenectady it was run out on the testing track and attached to the electric locomotive. Various runs were made, and those on the train expressed themselves as highly satisfied and pleased with the performance of the new locomotive.

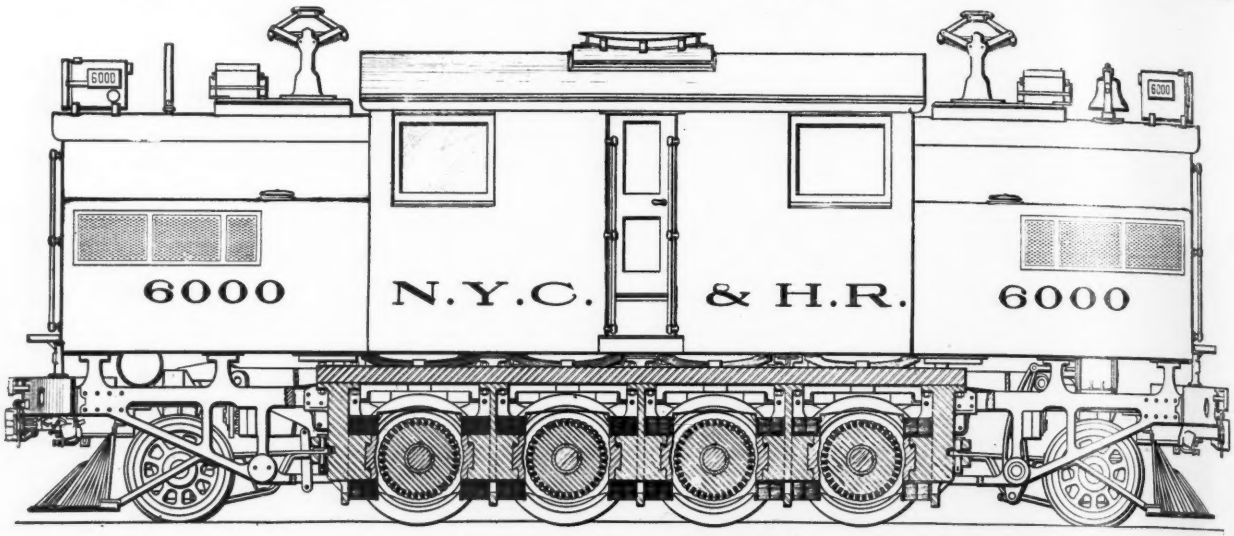
The party of newspaper men reached the testing track just at the conclusion of the official railway trials. The locomotive was then detached from the special cars and an opportunity given for inspecting it, the special train returning to New York. A good deal of time was spent in examining the new machine and having its interesting features pointed out. Later on a train of day coaches was attached to the locomotive, and a number of runs were made to show the operation of the locomotive.

One feature which attracted comment was the arrangement of the controlling apparatus within the cab. Everything is placed so as to be reached easily. The engineer has complete control from his seat, and the controlling mechanism is arranged so as to resemble, as nearly as possible, that of a steam locomotive. The controller handle is a horizontal lever, and the brake mechanism, sanding device and other accessories are practically identical with the steam equipment. There are, however, a number of other devices not seen on the steam locomotive. The indicating instruments are placed where they are in full view of the man in charge,

ELECTRIC LOCOMOTIVE FOR THE NEW YORK CENTRAL & HUDSON RIVER RAILROAD COMPANY.

and there is also an electric speed gauge which indicates approximately the speed in miles per hour.

The centre of the locomotive cab at the time it was exhibited contained a large table on which the recording instruments for making continuous records of voltage, current and speed were mounted. This



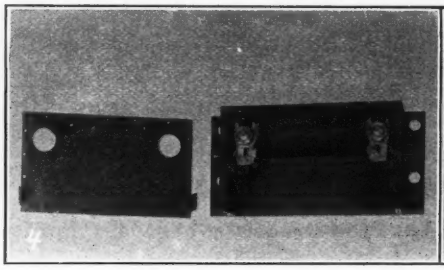
LOCOMOTIVE, SECTION THROUGH FRAME.

space will be occupied in the complete locomotive by a flash boiler for furnishing steam to heat the train during cold weather.

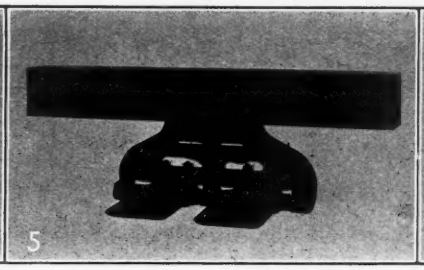
A feature of the new locomotive is the ease with which it runs and the comparatively little noise made. The rocking motion of the steam locomotive is absent, and it is difficult to realize the high speed which is being made.

On the runs made during the trial, speeds of something over sixty miles per hour were attained. On previous trials it is said that the speed has exceeded at times over seventy miles. The testing track is a section of the main line six miles in length which is being equipped rapidly with the third rail for experimental purposes, and at the present time the part which has been equipped is only four miles in length. There is thus no opportunity for determining the maximum speed which will be attained when drawing a very heavy train. It should be said that this locomotive has not been designed for very high speeds, but rather for high acceleration. The trials have shown that a speed of thirty miles per hour is attained within one minute with an eight-car train weighing, including the locomotive, 431 tons. This corresponds to an acceleration of one-half mile per hour per second. The rate of acceleration exceeded this during certain periods of the run, at one time amounting to 0.6 mile per hour per second, at which time a tractive effort of approximately 27,000 pounds was developed at the rim of the locomotive drivers. During one of the earlier trials a tractive effort exceeding this was obtained, where a momentary input of 4,200 amperes developed a value for the tractive effort of 31,000 pounds at the drivers, with a coefficient of 22.5 per cent of the weight on the drivers. The average acceleration with a four-car train, weighing, including the locomotive, 265 tons, was thirty miles in thirty-seven and one-half seconds, or about 0.8 mile per hour per second, equal to an average tractive effort of 22,000 pounds. This acceleration is considerably greater than that developed by a steam locomotive for the same service. The maximum input during this trial was 4,200 amperes at 460 volts, giving 1,933 kilowatts, which corresponds to an output of the motors of 2,200 horse-power available at the wheels. Had the full voltage of 600 been maintained, the input to the locomotive would have been 2,520 kilowatts or 2,870 horse-power output for the motors.

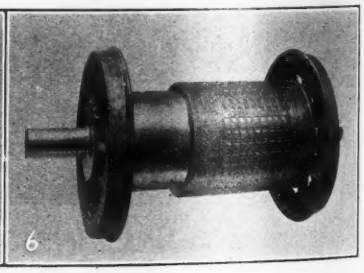
The present locomotive is the first of an order for thirty, with an option for twenty more. The present equipment is therefore somewhat experimental in regard to details. The endurance tests to which the machine will be subjected may possibly suggest certain modifications of these. The principal features of the design and equipment of this locomotive and the system adopted for generating and distributing the electrical energy, will be made clear from the following description and accompanying illustrations.



1,500-AMPERE FUSE BOX.



THIRD-RAIL SHOE.



ARMATURE, AXLE AND WHEELS (ASSEMBLED).

The New York Central & Hudson River Railroad Company is now equipping its terminal in New York city, for a distance of thirty-four miles on the main line, for electric operation. The Harlem division will be equipped to White Plains, a distance of twenty-four miles. All of the

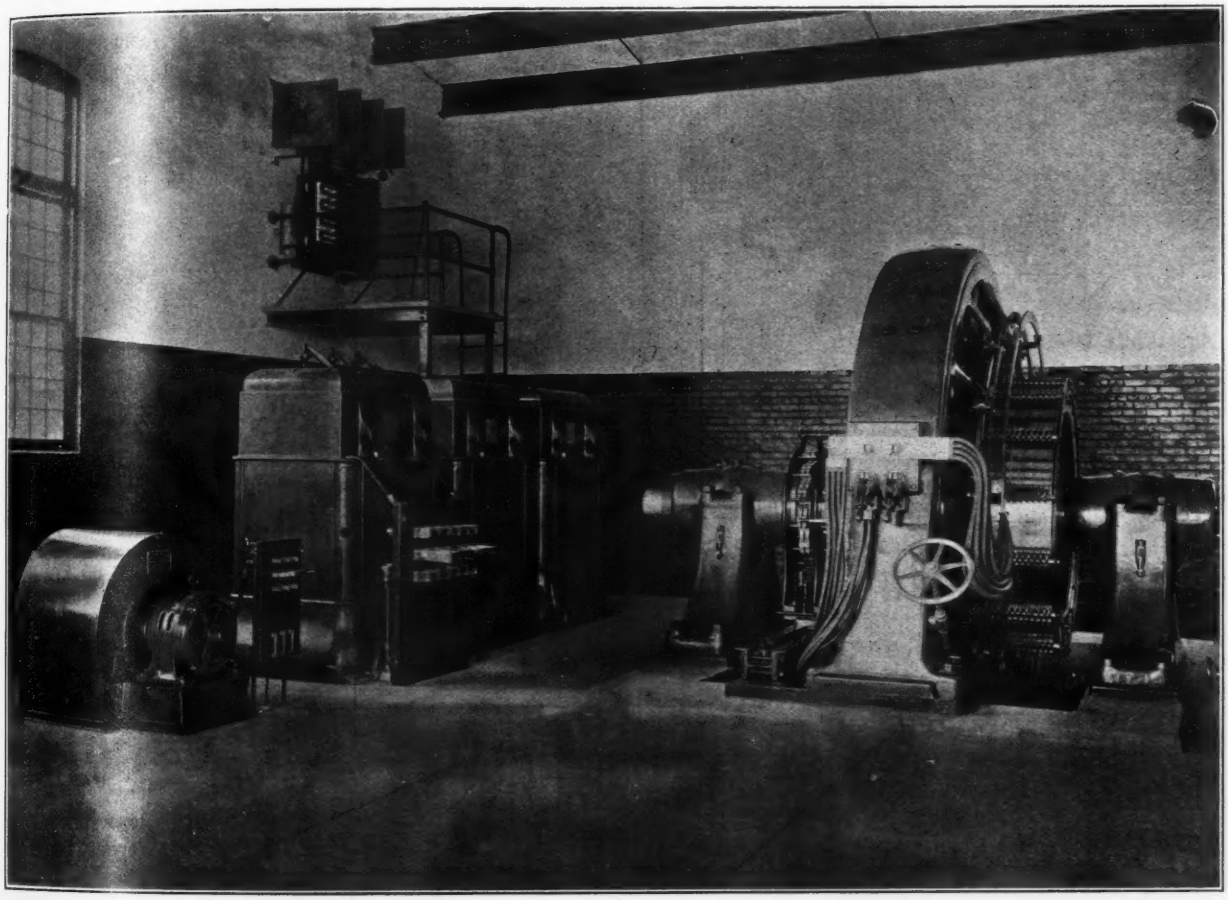
traffic within this zone will be handled electrically—the suburban traffic by means of the multiple unit system, the motors being mounted on the passenger cars, while the through trains will be met at the edge of the zone by an electric locomotive, the steam locomotive will be detached, and the former will draw the train into the terminal. The heaviest of these trains will be about 875 tons in weight, and the maximum speeds to be attained are from sixty to sixty-five miles per hour.

For this work a direct-current system was decided upon by the traffic commission created by the New York Central company, and the Sprague-General Electric multiple unit system of control was adopted. This system will be used not only on the electrically equipped passenger trains, but as well for the locomotives, thus permitting two or more locomotives—as the weight of the trains may demand—to be attached in tandem and operated by one man. In this way the heaviest trains will be handled without difficulty.

The general appearance of the locomotive is shown in the illustration. There are four pairs of driving wheels and two pony trucks for guiding the locomotive around curves. It has been sought in this machine to retain the best mechanical features of the high-speed steam locomotive, combining them with the enormous power and the simplicity of control made possible by the use of the electric drive. The superstructure of the locomotive is of sheet iron, arranged so as to house all the controlling mechanism and accessories, and yet leave a clear view for the engineer. The greatest departure from practice in electric locomotive construction is in the method of applying the electric drive. Direct driving is used, gears being done away with. The motor armature is mounted directly on the driving axle, without the spring-suspended quills which are a feature of the gearless electric locomotives used in the Baltimore & Ohio tunnel.

The sectional view shows in outline the scheme of driving. Four axles are spaced equal distances apart, each mounting an armature of a 550-horse-power motor. Between every pair of axles, and outside of the outer two, are the magnetic poles. These, it will be seen, are arranged in tandem, the magnetic flux passing directly through the four armatures in series, and returning through the cast-steel side-frames of the truck. The motors are two-pole machines, and are exceedingly simple in construction. The pairs of poles are carried by heavy steel transoms bolted to the side-frame, which provide an ample by-pass at intermediate points for carrying the magnetic flux should unbalancing occur. The pole-pieces are very nearly flat, and sufficient clearance is left in the air-gap to allow for the play of the armature. At the same time, the poles are so shaped that this movement of the armatures does not distort the magnetic field. This condition can only be obtained in a two-pole type of motor. The field coils are of heavy strip copper, wound flat upon metal spools, which are bolted to the pole-pieces.

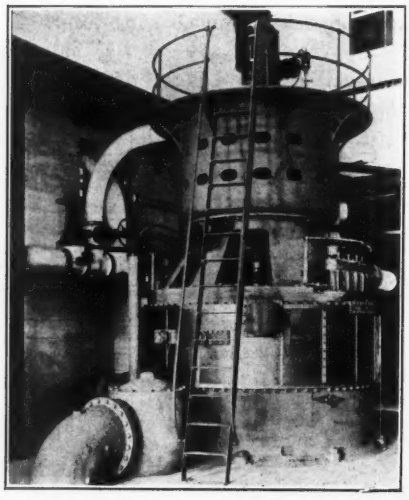
To obtain a proper distribution of the weight of the locomotive upon the four axles, a system of half-elliptic springs and equalizing levers of forged steel is employed, and the whole is so arranged as to cross-equalize the load and furnish three points of support. The mechanical simplicity of the arrangement of the truck and the motors is striking. The motors, in fact, form a part of the truck, and



INTERIOR OF SUBSTATION, SHOWING CONVERTER AND TRANSFORMERS.

are not, as heretofore, separate machines supported by the truck. The design, at the same time, is strong and one offering every facility for repairs and renewals.

The arrangement of the armature on the axle, as illustrated herewith, shows the entire space between the two driving wheels



2,000-Kilowatt, 4-Stage Curtis Turbine.

is practically taken up by the armature, possibly one-third of the longitudinal space being occupied by the commutator. A large commutator is necessary in this design, as there are but two sets of brushes. The main journals are outside of the wheels, and are thus easily reached for inspection. To remove an armature it is only necessary to run the locomotive

Overhead Special Work.

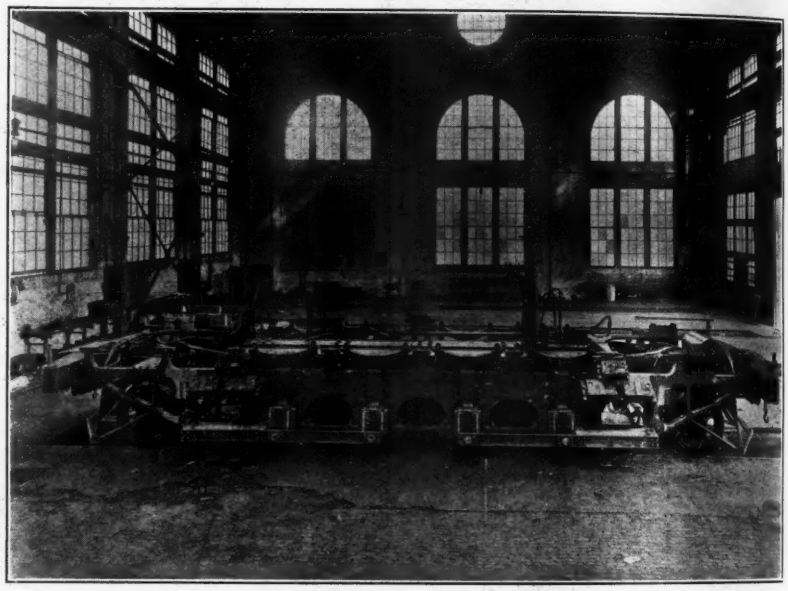
over a pit and drop the complete unit, consisting of axle, wheels and armature. It is not necessary to disturb the fields or any other part of the locomotive. A new unit is put in place as easily.

The brush-holders are mounted on insulated supports attached to the spring saddle over the axle journal. They are thus maintained in a fixed position in relation to the commutator. The brushes are placed on a horizontal axis, so that any little vibration set up should not affect them; and the brush-holders are made adjustable so as to allow for wear of the commutator and journal bearings. The dead weight on the axles is said not to be materially greater than that customary with steam locomotives, while in contrast to the latter there are no reciprocating parts and no unbalanced weights to produce vibration. It is thought that this feature will have a considerable effect in reducing the expense of maintaining the rails and the roadbed, as there will be no rolling or pounding.

The pony trucks—which, as mentioned above, are placed at the two ends of the locomotive for guiding—are similar in design to the standard construction adopted by the New York Central & Hudson River Railroad Company for its steam locomotives. They are pivoted, by means of radius bars, to the end-frame of the main truck. The frame of the locomotive above the trucks is supported by means of suitable links, so that the truck is free to swing about its centre and is self-centering on a straight track.

Within the cab the controlling devices, as already stated, are arranged so as to be reached conveniently by the engineer in charge. These devices are all in duplicate, so that a locomotive will be easily handled when running in either direction. There is a central passageway through the locomotive, enabling it to be entered from the car attached to it. This superstructure is practically in three sections, the central being an operating cab containing the indicators and the controlling handles. The two end compartments house over the contactors, rheostats, reversers, etc. These devices are arranged along the sides of the central corridor in boxes of sheet steel, which are sheathed on the inside with fireproof insulating material. All parts here are easily accessible for inspection and repairs.

The system of control gives three running arrangements—first, with all four motors in series; second, with two groups in parallel, each group consisting of two motors in series; and last, with all four motors in parallel. The master controller—views of which are given herewith—is operated by a horizontal lever



Locomotive Truck Partly Assembled.

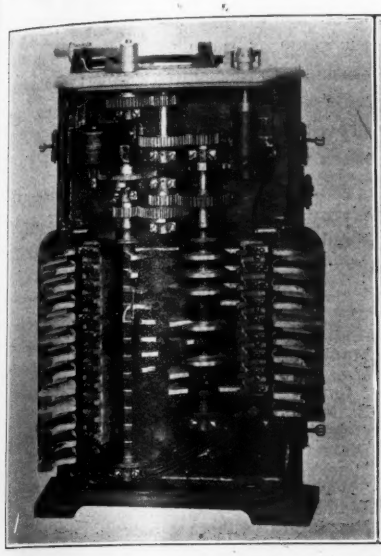
twenty-four inches long, instead of the usual handle. This lever moves through an angle of about seventy-five degrees. There are about ten steps in each of the three stages of control, but the engineer is not guided so much by these as he is by the ammeter placed before him. As the locomotive is intended for high accelerations, the process of starting is regulated so as not to overload the motors. For this purpose the ammeter serves as a guide. At the same time there is a current-limiting device attached to the master controller, and which consists of a friction clutch operated by an electromagnet which is energized by the current passing through one of the motors. The arrangement is such that, when the current exceeds a predetermined amount, this clutch locks the controller cylinder, preventing it from being moved until the

current has fallen sufficiently to release the clutch.

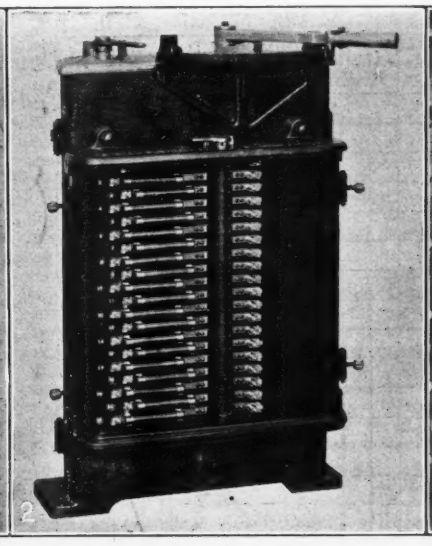
The air-compressor, which is placed in the locomotive cab, consists of a General Electric, motor-driven air-compressor with a capacity of seventy-five cubic feet of free air per minute. This is a twin vertical-cylinder compressor driven by two 600-volt, direct-current series motors. The compressor is controlled by a governor which automatically cuts the motors in and out of circuit when the air pressure falls below 125 pounds, or rises above 135 pounds. Should two or more locomotives be coupled together, a reduction in air pressure sufficient to actuate any one governor will simultaneously start up all of the air-compressors; and, likewise, when the air pressure has been raised so as to close down one of the compressors, all will be shut down simultaneously.

The current supply of the locomotive will be taken from a third rail by multiple-contact, spring-actuated shoes. There are four pairs of shoes similar to the pair illustrated. There are thus four shoes on each side of the locomotive. The third rail, which is mounted, as usual, alongside the track, is protected by an inclined cover of wood supported upon iron brackets. This arrangement of covering not only protects the rail from accidental contact with persons or the tools of the trackman, but its inclined position throws off water and, at the same time, keeps persons from walking along it. In the yards at the terminal and at road crossings the third rail is to be discontinued and its place taken by an overhead conductor which consists of a T-bar suspended from brackets. Contact is made by means of shoes mounted on top of the locomotive. These devices may be raised and lowered by air pressure controlled from the engineer's cab. In each collector circuit a fuse has been placed so as to secure protection in case of accidental short-circuits. These fuses are protected by special boxes supported on the truck just above the collecting-shoes, and may also be seen by referring to the large engraving.

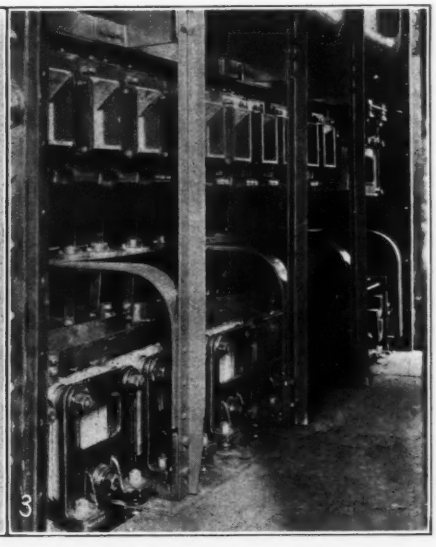
The testing track is located on the main



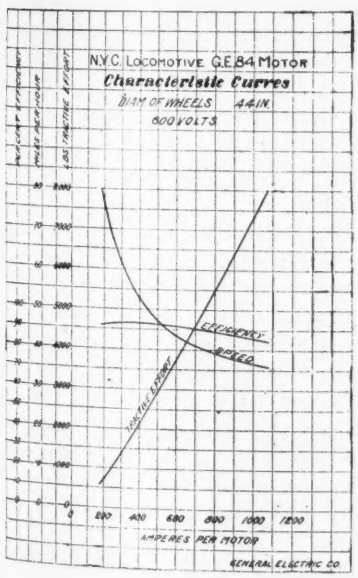
MASTER CONTROLLER, FRONT VIEW.



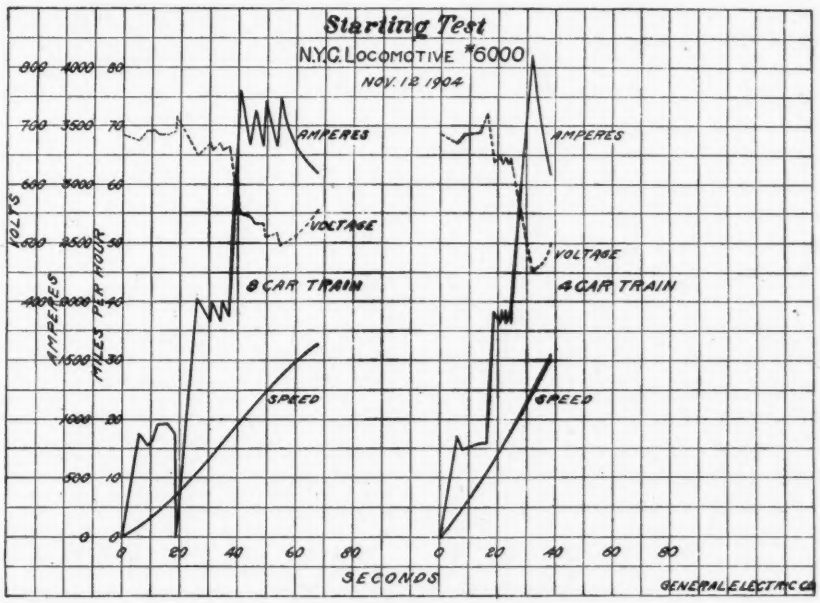
MASTER CONTROLLER, BACK VIEW SHOWING CUTOUT SWITCH.



CONTACTORS AND RHEOSTATS.

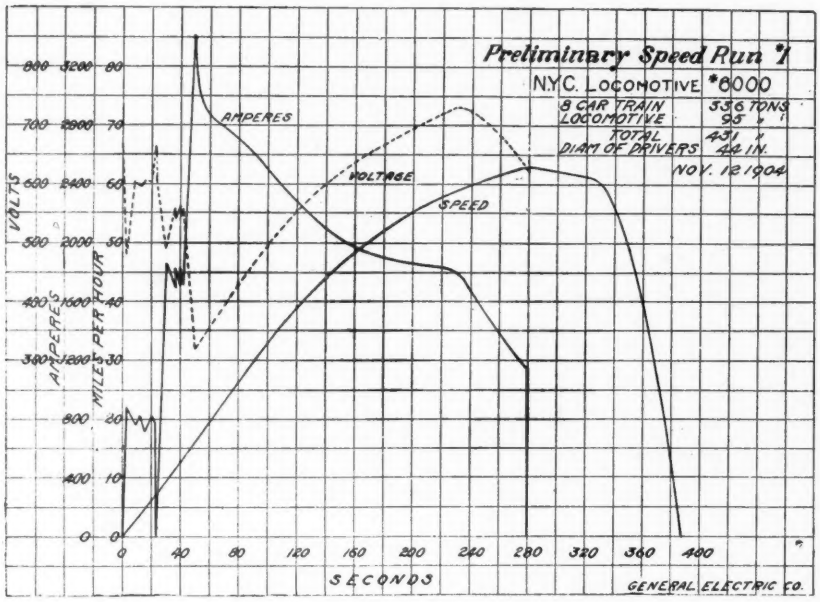


CHARACTERISTIC CURVES.

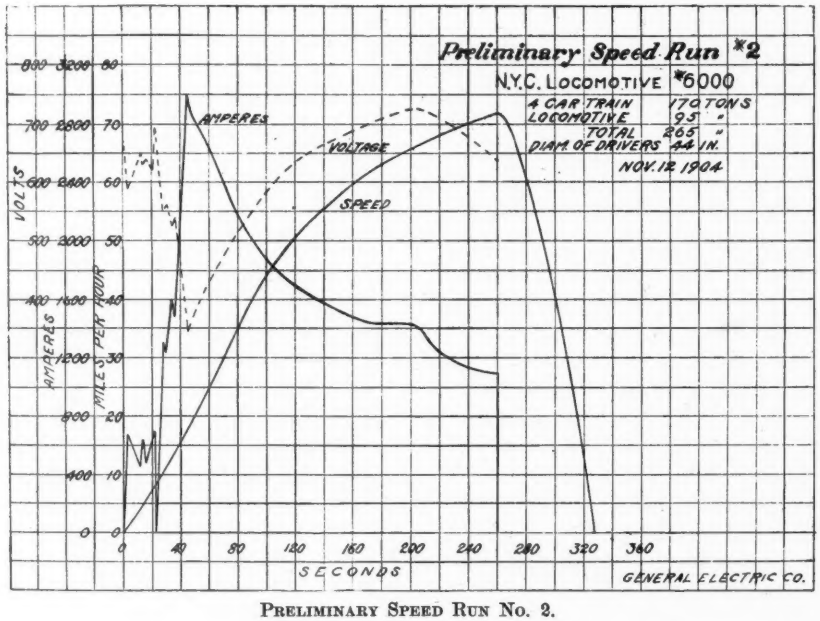


STARTING TEST.

line of the New York Central & Hudson River Railroad, between Schenectady and Hoffman's. The track is practically straight, and ballasted so as to permit maximum speeds of eighty miles per hour. The power for operating the locomotive is supplied by the General Electric Company from its power-house, where, for this purpose, a 2,000-kilowatt, three-phase, twenty-five-cycle, four-stage Curtis turbo-generator has been installed. This delivers current at 11,000 volts to the transmission line, which is five miles in length. A substation has been placed at Wyatt's crossing, an exterior view of this station being shown. The station contains a 1,500-kilowatt, 650-volt, twenty-five-cycle General Electric rotary converter with the necessary transformers for reducing the line potential from 11,000 to 460. There is also a switchboard containing a rotary converter panel, a starting alternating-current panel, and a high-tension panel fitted with electrically operated oil switches. The rotary converter is self-starting on the alternating-current side, no synchronizing or other complications coming in when putting the machine into service. The step-down transformers are provided with taps giving one-third, two-thirds and full voltage for starting the converter, these voltages being applied successively by means of double-throw lever switches. It is said that the machine starts freely and easily without sparking, and does not draw more than full-load current.



PRELIMINARY SPEED RUN NO. 1.



PRELIMINARY SPEED RUN NO. 2.

The general arrangement and the dimensions of this station are practically the same as those proposed for the substations to be built within the electric zone about New York city. Thus, the experience obtained from operating this plant will be of great value.

Some general dimensions and data applying to the locomotive are here given:

Number of driving wheels	8
Number of pony trucks	2
Total weight of the locomotive	95 tons
Weight on drivers	69 tons
Rigid wheel-base	13 feet
Total wheel-base	27 feet
Length over buffer platforms	37 feet
Extreme width	10 feet
Height to top of cab	14 ft. 4 in.
Diameter of drivers	44 inches
Diameter of pony truck wheels	36 inches
Diameter of driving axles	8.5 inches
Normal rated horse-power of locomotive	2,200
Maximum horse-power	3,000
Normal draw-bar pull	20,400 pounds
Maximum starting draw-bar pull	32,000 pounds
Speed with a 500-ton train	60 miles p. hr.
Voltage of current supply	600
Normal full-load current	3,050 amperes
Maximum full-load current	4,300 amperes
Number of motors	4
Type of motor	GE-84-A
Rating of each motor	550 h.-p.

While as yet no exhaustive tests of this locomotive have been made, the results of some preliminary trials and the characteristics of the motor are shown in the accompanying diagrams. These were taken for an eight-car train weighing 336 tons, and a four-car train weighing 170 tons, both exclusive of the locomotive. The total weight of the trains, including locomotives and passengers, was 431 tons and 265 tons, respectively.

The first pair of curves shows running tests. The maximum speeds here were sixty-three miles per hour for the eight-car train, and seventy-two miles per hour for the four-car train. This was the greatest speed that could be reached on the short track available, with the inefficient amount of copper at present in the supply circuit. The curves show that the trains were still accelerating when it became necessary to apply the brakes.

The second set of curves shows starting tests conducted under the conditions mentioned above, where the data collected from these tests have already been given.

The characteristic curves of this motor are shown herewith. As will be noticed, these resemble those of the standard traction motors, but it will be seen that

the curve showing the efficiency is considerably higher than that for a geared motor. In fact, the point of maximum efficiency is approximately ninety-three per cent, being fully four per cent better than is obtained with a geared motor. This gain in efficiency is particularly noticeable at high speeds, where the efficiency remains above ninety per cent even at the free running speed, in contrast with an efficiency of eighty-five per cent or less, which would probably be the showing of a locomotive equipped with geared motors.

The design of the locomotive showed evidence of great attention to details. The engineers went so far even as to make air-consumption tests of steam whistles, and as they found them to be very inefficient, a series of experiments was conducted to enable a highly efficient whistle to be constructed. The party of visitors was much pleased with the exhibition, and a good deal of favorable comment relating to the equipment as a whole, and to its various parts, was heard.

The return to New York was made at 4.20 P. M., dinner being served en route in a special dining-car. The party included representatives of nearly all the technical and daily papers located in New York city.

The special train, which left the previous night, carried the electric traction commission, consisting of William J. Wilgus, chairman, fifth vice-president of the New York Central & Hudson River Railroad; John F. Deems, general superintendent of motive power, and Bion J. Arnold, Frank J. Sprague, George Gibbs and Daniel B. Katte, consulting engineers. Among the foreign railroad officials present was H. H. Vreeland, president of the Metropolitan Street Railway Company, New York city. The New York Central was also represented by E. V. W. Rossiter, first vice-president; George H. Daniels, general passenger agent; E. Van Etten, second vice-president, and others. Among those present from the General Electric Company were C. A. Coffin, president; Eugene Griffin, second vice-president; W. B. Potter, engineer of the railway department; E. W. Rice, third vice-president, and L. R. Lovejoy, manager of the railway department. The American Locomotive Company was represented by J. A. Sague, vice-president; W. Dalton, chief engineer, and others.

American Institute of Electrical Engineers.

The one hundred and ninety-first meeting of the American Institute of Electrical Engineers will be held at 8.15 P. M., Friday evening, November 25, in the Chapter Room, Carnegie Hall, No. 154 West Fifty-seventh street, New York.

The following paper will be presented and discussed: "Problems on Electric Traction on the Long Island Railroad," by O. S. Lyford, Jr., electrical engineer, Westinghouse, Church, Kerr & Company, New York.

Electrical Equipment of the Subway.

On November 1 the following letter appeared in the New York *Sun* from Nikola Tesla concerning the electrical equipment of the subway of this city, and the power-house of the Interborough Rapid Transit Company:

"To the Editor of the Sun—*Sir:* I would not disturb the hymn sung by the press in praise of the subway had it not occurred to me that just these few fugitive moments of ecstacy offer the best opportunity for pointing out the necessity of its speedy reequipment. My idea is by no means as odd as it must at first appear to your readers. Permit me to explain.

"Electrical power transmission has been my specialty for many years. After the general adoption of my alternating system of distribution, popularly known as the 'two, three, multi or polyphase,' I turned my attention exclusively to currents of high tension and devised a scheme of artificial insulation of power, permitting an indefinite extension of the distance of transmission and doing away altogether with the loss in the mains. Finally, through a series of improvements, I arrived at my high-potential system, dispensing with wires, in which I have carried the arc of electrical energy transmission well toward its highest technical perfection and capacity of application. These inventions, abolishing all barriers to electrical development, will soon sweep the world with irresistible force.

"Naturally enough, I have been intensely interested in this great project, in the city of my home, from its very inception, and have devoted much thought to the best means to employ. The tunnel itself I have never seen and do not know its location. It must be a fine piece of engineering. I am compelled to confess to the same ignorance as regards the power-house. The Rapid Transit company has never asked me for any expert advice or suggestions and I have never been invited to examine any part of the work. It is true that my 'three-phase' system with my 'rotary converters' has been adopted, but it is precisely because of this that a change will be necessary in the near future. This combination of alternating and direct current should not have been employed. It represents the state of the art of more than ten years ago. In the power-house three-phase dynamos are installed. The electromotive force of the currents is raised by 'static transformers.' The high-tension currents operate in each of the sections of the road a 'rotating transformer,' in this case one of my three-phase synchronous motors having its field excited by and generating direct currents, which in turn, actuate the motors on the cars.

"Now, this plan, while operative, is for a great many reasons objectionable, more so in this particular instance. The subway problem was peculiar. The length of the circuits was insignificant. The facilities for placing and insulating the mains were great. Financial limitations, which usually hamper an electrical enterprise, did not exist. There was money to burn. The quickness of travel, the safety of the public and of the adjacent property were the dominating requirements. These have not been properly met. A mistake was made in not asking the electric companies to furnish the best instead of the cheapest equipment.

"But it is better to mend late than never. Ignoring the improvements which might be made in the power-house, the mains should be insulated artificially by refrigeration. This would save the energy which is now lost in the mains and money besides. More than this, it would ensure complete safety against any breakdown of the insulation, which, however, would be self-restorative. The 'rotating transformers,' introducing many elements of incertitude and danger, should be done away with and 'static transformers,' if necessary, installed in the substations. Direct currents, which are a constant menace to life and property, despite subdivison, should be most certainly avoided. Motors of this kind, with their brushes and commutators, sparks, copper dust, nitric acid and what not, are not suitable for so important a thoroughfare, and should be replaced by my 'induction motors' without brushes and commutators, and perfectly free from the innumerable troubles these devices entail. It would be advisable also to employ a greater number of correspondingly smaller motors on each car. This would be, in my opinion, an entirely safe, economical, and in the long run the cheapest apparatus, which could be taxed, without the slightest risk, in the hours of rush, to its utmost capacity, and which, if properly constructed, should last a century.

" To conclude, as I examine the equipment of the subway, I find that about all to be preserved would be Mr. Belmont's beautiful car, this as a *corpus delicti.* The changes suggested will have to be made sooner or later, and I am quite earnest in recommending an immediate appropriation and commencement of this work of reconstruction without delay, else Philadelphia will have an underground railway several decades ahead of ours. N. Tesla.

"New York, October 30."

In the issue of the *Sun* of November 11, Lewis B. Stillwell, electrical director of the Interborough Rapid Transit Company, makes a reply, as follows:

"To the Editor of the Sun—*Sir:* So far as engineers are concerned, the letter of my friend, Mr. Tesla, printed in your paper of November 1, answered itself, and but for his reflection upon the business policy of Mr. Belmont and his associates no comment would be necessary. In stating that 'a mistake was made in not asking electric companies to furnish the best instead of the cheapest equipment,' however, Mr. Tesla makes a serious charge, directed, apparently, not at the engineers of the Interborough Rapid Transit Company, but at its management, and in justice to these gentlemen, who have performed their part in a quasi-public enterprise in a most liberal and thorough manner, it seems proper for me, as the engineer responsible for the electrical equipment, to say that Mr. Tesla's statement is entirely erroneous.

"In providing an equipment costing more than twice as much as was contemplated at the time the contract with the city was executed, Mr. Belmont and his associate directors have imposed upon their engineering advisers no limit of cost. If any mistake in the selection of the electrical equipment has been made (and Mr. Tesla offers no evidence that such is the case), the mistake is mine and not Mr. Belmont's. It is a pleasure to emphasize the fact that no company with which I have been connected in carrying out an important work of engineering construction involving the expenditure of large sums of money ever impressed more strongly upon its engineering advisers the wish of its management to secure the best attainable results, nor allowed its technical staff greater latitude with respect to methods and expenditure.

"Mr. Tesla's letter can not be discussed with profit in the columns of the daily press, and my recollection of what he has done for electrical progress in the past is so vivid that I am disinclined to comment upon his technical suggestions, which perhaps appear more plausible to the average reader than to the engineer. I would suggest to Mr. Tesla, however, that a paper from him containing specific and definite criticism of the electrical equipment of the subway might be presented before the American Institute of Electrical Engineers, and that if he will present such a paper I shall be glad to meet him upon such an occasion for the purpose of a full and frank discussion. L. B. Stillwell.

"New York, November 9."

Reviews of Current Engineering and Scientific Literature.

An Electric Train-Lighting System.

In this article M. R. Lechein describes the Aichelé train lighting system, which is built by Brown, Boveri & Company, and which has been adopted on the Swiss railways. This is an axle-light system, each car being equipped with a small generator and storage battery. The dynamo is driven by means of a belt connected directly to the storage battery. It is rated at two horse-power. The battery is rated at 140 ampere-hours. The regulating device, which is automatic, consists of a small motor controlling the exciting rheostat of the generator, the dynamo being disconnected from the system when the speed is below a certain minimum.—*Translated and abstracted from Electro (Brussels), September.*

On the Use of an Electromagnet for Removal of a Foreign Body from a Bronchus.

An account is here given of the successful use of an electromagnet in removing a foreign body which had been swallowed by a small child. The child was sixteen months old, and while playing with a shingle nail had swallowed it. A Rœntgen-ray examination a week after the accident showed that the nail was in the left bronchus, behind the base of the heart, a point from which removal would be difficult and dangerous. It was suggested to attempt extracting the nail by means of an electromagnet. One was accordingly designed, which consisted of a Norway iron core five-eighths of an inch in diameter and eleven inches long, wound with 9,000 turns of No. 24 double-covered magnet wire. The magnet was to be used on a 250-volt, direct-current circuit. Its resistance was 160 ohms. The end of the core was drilled and tapped to receive any one of a number of pole-pieces of different shapes. The lifting power of the magnet was 100 grammes. The pull was sufficient to attract a shingle nail through two inches of space. Thirteen days after the nail was swallowed Dr. Hosmer made a low incision and introduced the tip of the instrument down along the trachea as near as possible to the nail and turned on the current. A sharp click followed, and upon withdrawal of the magnet the nail came with it.—*Abstracted from the Archives of Electrology and Radiology (Chicago), October.*

Two Continental Power Stations.

Two important Continental power stations are described briefly by Mr. A. Steen in this article. One is in course of construction at St. Denis, France. The equipment consists of four Brown-Boveri-Parsons turbo-alternators of 5,000 kilowatts each, with a speed of 750 revolutions per minute. The alternators supply three-phase current at a pressure of 5,000 volts and a frequency of twenty-five cycles per second. Each group is provided with a surface condenser and air and circulating pumps, which are operated by a continuous-current motor. The station also contains a storage battery with a capacity of 1,300 ampere-hours. The turbines have a working pressure of 180 pounds per square inch, the steam being superheated to 350 degrees centigrade. The other station is being built at St. Ouen, France. The machinery will also be constructed by Brown, Boveri & Company, and will consist of turbo-alternators rated at 5,000 kilowatts each, running at 750 revolutions per minute. The turbines generate three-phase current at 5,000 volts with a frequency of twenty-five cycles per second. The station may also contain a storage battery rated at 2,300 ampere-hours. The steam turbines were constructed for a working pressure of 170 pounds. The steam will be superheated to 360 degrees centigrade.—*Abstracted from the Electrical Review (London), October 28.*

Calculation of Tramway Networks.

Excessive loss of voltage in the supply system of electric tramways causes a double loss financially—first, that due to the loss of energy itself, and, second, the loss due to the decrease in traffic caused by the consequent decrease in speed. Hence it is important that, in laying out the conducting system, no effort should be spared to secure the best effect for a given outlay. In this study M. E. A. Kerbacker considers first the methods of calculating the performance of an electric railway by means of special diagrams giving the power, speed, current, etc., for different cars under all possible conditions. While this method is generally used, it is laborious, and the reliable results can be obtained only by assuming numerous positions of cars and calculating for each case the resulting voltage throughout the system. The author then considers a method used in Berlin and Milan for computing the lighting systems. This is in reality an old plan which was tried in this country many years ago, but does not seem to have met with much favor. It consists in constructing, on a miniature scale, a model of the system and determining, by actual experiment, the fall of potential which takes place. The supply system, as well as the track return, is formed of suitable resistance wires which are supported on small posts attached to the map representing the system. The cars are represented by small resistance coils simply constructed and arranged so that the current taken by each may be varied easily. The advantage of such a system lies in the ease with which the value of different arrangements can be determined.—*Translated and abstracted from L'Éclairage Électrique (Paris), October 29.*

The Design of Generators for Electric Power Transmission.

There are, according to Mr. D. B. Rushmore, certain peculiarities in high-voltage power transmission which differentiate, to some extent, the requirements which a generator must fulfill from those in other kinds of work. The voltage of the line, and sometimes of the generator, is high. The power-house is often situated at some distant mountain locality which is difficult of access. The machinery must be hauled many miles over newly made roads, and must often be especially designed. Mountain valleys, especially in the neighborhood of streams, are very damp places, and as there is no artificial heat in the power-houses, machines must be subjected to moisture. Long lines, in some cases between 100 and 200 miles—and double lines at that—offer a great many opportunities for trouble, and the number of severe strains on the apparatus is large. Such supply systems usually have a considerable portion of the output utilized by induction and synchronous motors, which produce great disturbances on the line. Such systems are also much affected by lightning discharges. The water-wheels which drive the generators are likely to have a certain amount of vibration when the head of water is over 700 feet. They run at high speeds, thus necessitating few poles and concentrated reactions. The

peripheral speed and mechanical strains are also high. Mr. Rushmore then takes up in detail the different features of the construction of a generator, such as insulation and methods of connecting the windings, attention under this head being called to the effect of the third harmonic when delta-connected transformers are used, as this may cause an excessively heavy current to circulate through the transformers. In parallel-running generators the different types of alternator and the stability of these for such service, the methods of securing good regulation, and the other features of this important phase of electrical work, are taken up in detail. This is followed by a satisfactory description of a recent machine built for one of the California transmission systems.—*Abstracted from Engineering News (New York), October 27.*

The Production of Ozone in the Siemens Generator and an Improved Construction of This Apparatus.

An investigation of the efficiency of the Siemens ozone generator has been made by Mr. Arthur W. Gray. The research required a good deal of preliminary study, in order that a suitable device for regulating the voltage and for measuring the quantity of electricity passed through the air might be devised. The method adopted consisted in driving, by means of an electric motor, a Toepler-Holtz machine. One pole of this machine was earthed, and the other was connected to a large Leyden jar and a Braun electrometer. In order to determine the quantity of electricity passed, a commutator was constructed which would record the number of discharges passed through the gas and, from time to time, one of these discharges was passed through a ballistic galvanometer. The ozone generator used was of the usual construction, with only a very short length of glass surface separating the walls bounding the gas space. It seemed probable that a portion of the electricity passing from one side to the other took this path instead of going through the gas. To eliminate this defect a new generator was constructed, consisting of two glass bulbs, one within the other, and held in position by long glass stems. The electrodes consisted of silver deposited on the glass. Care was taken in the construction of the generator to get the walls bounding the gas space as nearly parallel as possible. When first attempting to measure the quantity passed during the discharge, it was found that the galvanometer behaved very erratically, due to an electrostatic charge accumulating on the insulating material of the coil. To eliminate this difficulty a condenser of large capacity was connected in parallel with the galvanometer. The discharge then flowed first into the condenser, which immediately afterward discharged itself through the galvanometer. The results obtained are given in tabular form and plotted charts. They indicate that the mass of ozone produced per coulomb increases with the potential difference applied between the electrodes of the generator, and that this increase is apparently directly proportional to the increase in voltage. The insertion of a high resistance in the circuit decreases the quantity of electricity, and also decreases the quantity of ozone produced per coulomb of electricity passed through the gas. The production of ozone, when moist oxygen was passed through the generator, was less by from ten to fifteen per cent than when well-dried oxygen was passed. Conditions favorable to the economical production of ozone are: the surface and insulation of the generator, both internal and external, must be good; the oxygen must be dry; charging and discharging must take place as suddenly as possible, hence the resistance and inductance of the circuit should be reduced to a minimum.—*Abstracted from the Physical Review (Lancaster), November.*

Gas Turbines.

In the last issue of the ELECTRICAL REVIEW we published an abstract of a paper entitled "A Scientific Investigation of the Possibilities of Gas Turbines," by Mr. R. M. Neilson. An abstract is here given of the discussion on this paper, in which many took part. Mr. Henry Davey described a small vertical boiler he had used, in which air and gas under pressure were burned in a firebox lined with firebrick. The flame passed out through water and steam spaces to a chamber at the top. A spring-loaded valve on the boiler allowed steam to pass from the latter into the gases when a certain boiler pressure was reached. The mixed fluid was then conducted to the turbine. Difficulty was met from the gases occasionally failing to burn in the firebox, which resulted in alarming explosions in the upper chamber. Mr. Davey had also tried igniting the gases in a separate apparatus, and found that a fairly constant pressure could be maintained in this way. Professor Burstall thought that Mr. Neilson had taken a rather optimistic view of the case, though he himself believed that the difficulties would eventually be overcome. Professor Burstall had devised a number of gas turbines, and found great difficulty in making a satisfactory one. One trouble lies in the poor efficiency of the rotary compressors. He thought that a gas turbine on the Parsons principle would be impossible, because the cooling effect would be so rapid as to prevent any reasonable efficiency. This would be the greater in the turbine, since practically all the gases come in contact with the metal surfaces. In a reciprocating engine it is only the outer layers which touch the metal. Mr. James Atkinson anticipated a great deal of difficulty on account of the high temperatures which would be reached. This would cause rapid oxidation and a great scouring action. Mr. H. M. Martin thought that higher efficiencies could be obtained with rotary compressors, and mentioned one driven by a turbine, which has given an efficiency of sixty-one per cent. The compressor, it is probable, gave an efficiency of about eighty per cent. He suggested reducing both the temperature and the velocity of the hot gases by passing them through a nozzle built on the injector principle, so as to draw in air. Professor R. H. Smith also credited compressors with a better efficiency than those mentioned in the paper. He pointed out, further, that Carnot's formula is deduced for an ideal engine, and that it is an historical fact that every engine that worked successfully had had to cut down its upper temperature limit to get greater efficiency. Mr. W. J. A. London doubted whether a turbine of the Parsons type could be used with such hot gases. The edges of the blades would certainly not stand very high temperature for any length of time. He did not think that water-cooling would be practicable, since cooling the drum would protect the blades but slightly. Development along the line of the De Laval turbine seemed to him more probable. The steam turbine gains mostly because it expands the steam to a very low pressure. In reply to these remarks, as well as to others, Mr. Neilson said that one advantage of a gas turbine would be the possibility of utilizing a greater expansion of the gases. The difficulty of obtaining a metal suitable for constructing a turbine of the De Laval type was admitted, but it is not impossible that this might be obtained in the future. He thought that mixing the gases with air would not be practicable, on account of the large loss of heat which would thus be caused. He had little faith in a turbine cooled by circulating water.—*Abstracted from Engineering (London), October 28.*

INDUSTRIAL SECTION.

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

New Electrical Specialties.

The accompanying illustrations show several specialties which the Marshall Electric Manufacturing Company, Boston, Mass., has recently devised and placed on the market. Fig. 1 shows a special angle-wall socket for lighting show-windows and other places where incandescent lamps are used with shade-holders. The base of this socket is on an angle, and the shade-holder and shell are made in one piece. They are made both key and keyless, and with a pull mechanism to turn the lamp on and off by a chain.

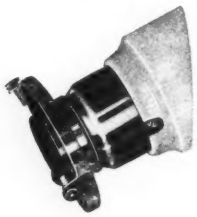


FIG. 1.—ANGLE WALL SOCKET.

FIG. 2.—T.-H. ADAPTER.

Fig. 2 shows a new T.-H. locking adapter which, when once screwed into the socket, can not be readily removed. This is accomplished by a number of spring wings or stops which bend downward when the adapter is screwed on or forward, but which catch on the porcelain of the socket when turned backward.

Fig. 3 shows the new form of snap switch which this company has recently designed. The working mechanism is made of hardened steel, and the mechanical features are decidedly simple. The mechanism consists of a spindle with a projecting arm which fits into a recess in the locking bolt, which, in turn, engages a four-stop ratchet. The springs are of tungsten steel with phosphor-bronze contacts. The cover—a unique feature of this switch—is lined by a cup of "Elastoid" fibre made in one piece, without wrinkles or seams. The handle is claimed by the maker to be unbreakable. The bases are made both for open and concealed work. The entire switch is made in accordance with the National Standard Code in every respect.

FIG. 3.—SNAP SWITCH.

Transmission of Messages Simultaneously Over the Same Wire.

Professor Mercadier, of the French High School for Posts and Telegraphs, has invented a new system for sending a number of messages simultaneously over one wire. In this method an alternating current is employed, and its frequency depends upon a tuning fork having a certain definite number of vibrations. The current in such an interrupted circuit can be broken by an ordinary key, and signals transmitted over the line by an induction transmitter. At a distant station are a number of so-called monotelephones, which respond to a current of predetermined frequency and are tuned to the forks in the circuits at the sending station. Each particular circuit has its own telephone, which is connected by tubes with the ears of the receiving operator and responds to the signals made at the sending station. In all twelve transmission circuits are provided, so that twenty-four messages may be sent over the line simultaneously.

The Whitney Tester.

The Whitney Electrical Instrument Company, Penacook, N. H., is manufacturing a lineman's testing set, to take the place of magnetos in testing out lines and electrical apparatus for continuity of circuit and freedom from grounds and crosses. The tester shown in the illustration consists of a simple and strongly constructed voltmeter mounted together with a couple of batteries, a small rheostat and a pair of terminals in a hardwood box.

The connections in the box are such that, when the cord ends are touched together, the batteries are applied directly to the voltmeter terminals, the rheostat being so adjusted that the voltmeter then shows full scale. If a resistance be interposed between the terminals it will be in series with the voltmeter, the needle of which will then fail to reach full scale deflection by an amount proportional to the value of the resistance.

A table showing what number of scale divisions corresponds to different resistances is secured in the cover of the box, so that in taking a reading all that is

WHITNEY LINEMEN'S TEST SET.

necessary is to touch the cord terminals to the circuit to be tested and then read the resistance by reference to the table. The maximum current that can be drawn from the batteries is the exceedingly small amount required by the voltmeter. The rheostat is made adjustable from the outside by means of a screw-driver, so that after the battery voltage has fallen off the instrument can still be made to give full deflection on a short-circuit. The testers are made in two ranges, one giving a deflection through 5,000 ohms maximum and the other through 25,000 ohms maximum.

Machado & Roller, 203 Broadway, New York city, are sales agents for this apparatus.

The New "Standard" Dry Battery.

The following details of construction and performance of the new "Standard" dry battery will be of interest to users of this class of apparatus. The cell weighs about two pounds complete, including paper carton. The internal resistance has been determined to average 0.12 ohm with a voltage of 1.52, while the short-circuit current is from fifteen to eighteen amperes.

The curves shown herewith have been developed from data secured by exhaustive tests. Fig. 1 shows the drop in voltage and the watt output while the cell was discharging through a resistance that maintained a uniform discharge rate of two amperes. The starting electromotive force with the resistance in circuit was 1.18 volts, three hours and ten minutes was required for the voltage to drop to 0.3 volt, the drop being uniform in respect to time. On releasing the cell from the test, the voltage recovered to 1.2 volts in twelve hours.

Fig. 2 shows the discharge curves of a cell having a constant resistance of 0.179 ohm in circuit. The current started at five amperes, and after a period of two hours had dropped slightly below two amperes. On open circuit the cell quickly recovered to 1.2 volts, as in the first test.

Fig. 3 shows the behavior of the cell under short-circuit, and its subsequent recovery. The cell was short-circuited through 0.56 ohm and started with ten amperes discharge. In two hours and fifteen minutes the current had dropped to two amperes. On release, the electromotive force immediately recovered to 0.7 volt, and in two hours and forty minutes to 0.965 volt. A further test was made, in which the conditions that would obtain in automobile service were duplicated as nearly as possible. When operated under interrupted load, the cell ran for three hours and twenty-five minutes with rests between each hourly period. It was found that the current fell uniformly from 6.2 amperes to 5.2 amperes during the test, the open circuit voltage falling proportionately. Immediately after this test another was made on the same cell, in which the interrupter was changed to increase the short-circuit period from one-thirtieth to one-quarter of the running time. This test extended over a period of twenty-eight hours of running time, and sixty-nine hours and twenty-six minutes in rests. The latter were divided into approximately hourly periods. At the start of the second test the cell showed a discharge of 4.2 amperes; at the close, 1.2 amperes. The capacity for delivering current fell off uniformly throughout the run. At the close of the test the cell showed a strong tendency to recover its voltage and current-producing capacity.

The manufacturer of this cell is William Roche, 52-54 Park Place, New York city.

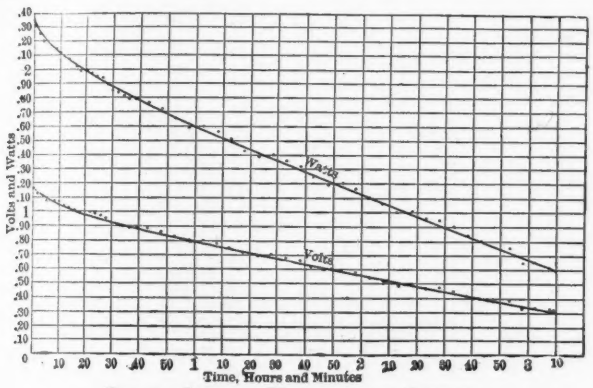


FIG. 1.—DROP IN VOLTAGE AND OUTPUT.

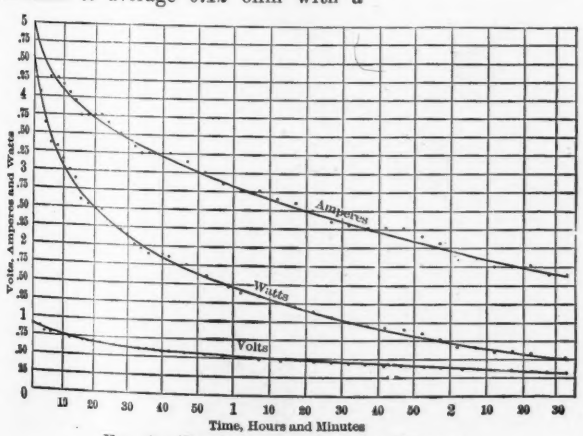


FIG. 2.—VOLTAGE AND AMPERE CURVES.

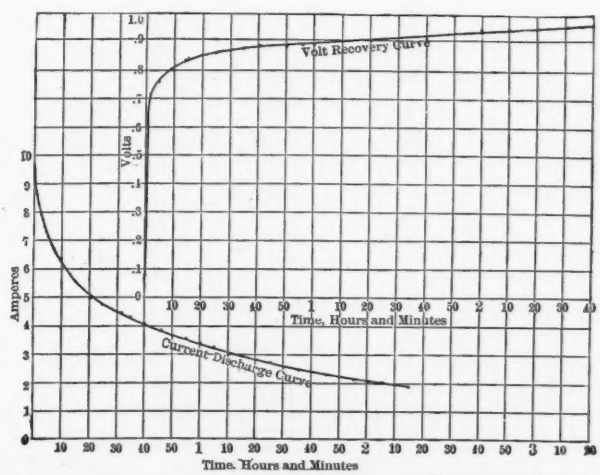


FIG. 3.—DISCHARGE ON SHORT-CIRCUIT, AND RECOVERY CURVE.

A Departure in Street Railway Service.

The Boston & Northern Railway and the Old Colony Street Railway, of Boston, Mass., have created a passenger department with headquarters at 309 Washington street, Boston. Mr. Robert H. Derrah has been appointed passenger and advertising agent of the two companies. Under his supervision the public will become more fully acquainted with the many seashore resorts, historical places and opportunities for recreation which the lines of these two companies furnish. In addition to these resorts the company owns and maintains a number of other parks during the summer months.

Mr. Derrah, the new passenger agent, is well known to the street railway fraternity, and has been prominently con-

nected with the problem of creating pleasure travel on trolley lines throughout the New England states.

The companies which Mr. Derrah represents operate 800 miles of street railways north and south of Boston, extending from Nashua, N. H., through the state of Massachusetts to Providence and Newport, R. I. These systems serve some twenty-two cities and sixty-six towns, with a total population of over 2,000,000.

The Automatic Electric Company at the World's Fair.

The Automatic Electric Company, Chicago, Ill., announces that the Jury of Awards of the Louisiana Purchase Exposition has awarded the grand prize to its exhibit of automatic telephones and switchboards. This award is for general excellence in group 70, which includes all forms of telephone switchboards, telephones, telephone apparatus, appliances, and appurtenances and supplies.

The company's exhibit is one of the most interesting and noteworthy at the exposition. It occupies a conspicuous position in section 24 of the Palace of Electricity, and is housed in a finely appointed pavilion of its own. The exhibit proper consists of a complete automatic telephone exchange of the 10,000-equipment type, divided into two switchboards and having power equipment and all other accessories. To this exchange are connected a large number of telephones scattered throughout the exhibit and the Palace of Electricity. The automatic service has been in constant use by the officials of the electrical building since the opening of the fair.

The exhibit is in charge of Harry S. Durant, of the sales department of the Automatic Electric Company, assisted by James Strasburg, of the mechanical department.

The Automatic Electric Company has, within the past two years, equipped more than sixty cities in the United States with its automatic telephone apparatus.

AUTOMATIC ELECTRIC COMPANY'S EXHIBIT AT THE WORLD'S FAIR.

A New Conduit Pipe Hanger.

The Atlas Hanger Manufacturing Company, 1841 Park avenue, New York city,

FIG. 1.—CONDUIT PIPE HANGER.

is offering a new conduit-pipe hanger which is intended to overcome the usual difficulties of providing a satisfactory support for electric conduits in exposed places. It enables conduits to be hung within one inch of the ceiling or support.

It is made in a number of styles, as shown in the illustrations. Styles A and B are made to take pipes varying in size from three-eighths inch to one inch in diameter. Style A, shown in Figs. 1, 2 and 3, consists of a hollow spherical shell, cast in two pieces, and mounted on a pivot; the shell is made to grip the pivot by means of two small screws. The pivot is furnished either with a wood screw, or an I-beam clamp as shown.

The clamp is adjustable to any size of beam. Style B is similar to style A, except that it is cast in one piece. It can be used either with a wood screw or beam clamp.

Style C is split horizontally and hinged. It is used in places where it is desirable to move the conduit without disturbing the beam clamp. Fig. 4 shows style D, which is made for the larger sizes of pipe, and can be used with a clamp or wood screw.

FIG. 2.—CONDUIT PIPE HANGER.

Style J, Fig. 5, is similar to style A, but is adapted for use as a junction box. It is heavily coated on the interior with enamel for insulation purposes. One or more outlets are tapped, if desired.

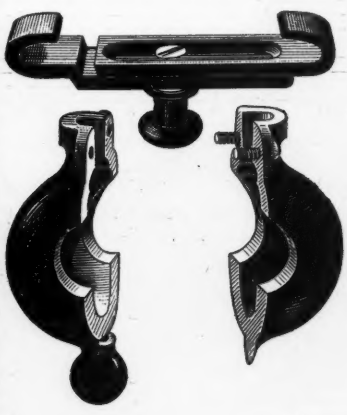


FIG. 3.—CONDUIT PIPE HANGER.

FIG. 4.—CONDUIT PIPE HANGER.

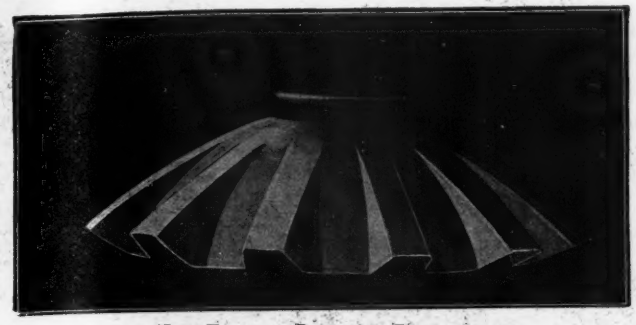
The smaller sizes are made of brass or malleable iron, and polished or nickeled.

FIG. 5.—CONDUIT PIPE HANGER.

The hangers for pipes over one inch in diameter are made only of malleable iron.

A New Form of Patented Reflector.

The accompanying illustration shows the new "X-ray" reflector manufactured by the National X-Ray Reflector Company, 185-187 Van Buren street, Chicago, Ill. These reflectors are built upon scientific principles, and are so designed that the



A New Form of Patented Reflector.

factor of reflection multiplies the lighting power of each lamp. The reflector shown herewith is a patent combination reflector for Welsbach lights. By its peculiar construction a single reflector is said to throw a twenty-foot circle of concentrated light from an ordinary height. These reflectors are applicable for use with either gas or electric lamps. They are being largely used by prominent merchants for extensive lighting. Marshall Field & Company, Chicago, Ill., are using 1,500 of these reflectors.

Allen-Bradley Controllers Being Tested for Government Use.

The Bethlehem Steel Company has installed at its exhibit in the Mining Building, at the World's Fair, St. Louis, a 110-volt, seven-horse-power Allen-Bradley electric controller for use in connection with the naval gun, which forms the principal part of the Bethlehem Steel Company's exhibit. The Allen-Bradley controller was selected by the engineer in charge, Mr. James Watters, as embodying a number of new features, making it specially adapted for use in connection with big guns.

It is stated that the Allen-Bradley controller gives perfect control of the large gun with which it is being tested, and that it affords great adaptability to perfection of aim and delicate handling. A number of United States and foreign naval and army officers have inspected the Allen-Bradley controller in connection with the Bethlehem Steel Company's exhibit and have pronounced it highly successful.

The Bethlehem Steel Company proposes to remove the present exhibit at the conclusion of the World's Fair, and to make a permanent, practical exhibit, including the Allen-Bradley controller, at its works at South Bethlehem, Pa.

The American Electric Fuse Company, of Chicago, which manufactures the Allen-Bradley controller, states that it has made a number of tests with the Allen-Bradley machine, which demonstrate the fact that there is practically no limit to the control which it affords in connection with the handling of big guns, either in land fortifications or on board battleships. The American Electric Fuse Company also states that the United States government experts, who are investigating the merits of the Allen-Bradley controller, have found it satisfactory in results upon all tests made.

Annual Meeting of the American Trade Press Association.

At the annual meeting of the American Trade Press Association, held at the rooms of the Hardware Club, New York, Thursday evening, November 10, the largest attendance in the history of the association was present. Mr. E. C. Brown, who has been the able and popular secretary and treasurer of the association for the past four years, was presented with a beautiful and elaborate silver set in recognition of his services and the good will of the members of the association. Officers were elected as follows, after which the annual dinner followed: president, J. H. McGraw; vice-president, J. A. Hill; second vice-president, F. E. Saward; third vice-president, E. C. Brown; secretary-treasurer, L. J. Montgomery. Directors: J. D. Crary and Franklin Webster.

Mr. E. P. Harris delivered an interesting address on "The Function and Management of the Specialized Journal," which was discussed by a number of those present.

Electrifying the New Williamsburg Bridge.

As was noted recently cars were started running over the new Williamsburg bridge, the most recent link connecting the boroughs of Manhattan and Brooklyn, to be thrown open to the public. It may be remembered that it is but a short time since the contract for electrical construction was awarded, so that its completion is a matter of congratulation to the number of daily travelers that it accommodates.

The electrifying of the double tracks operated by the Brooklyn Heights Railroad Company, paralleling the south roadway, has recently been completed by the firm of J. G. White & Company, incorporated, 43-49 Exchange Place, New York city. The contract for the work was undertaken through Naughton & Company, who had the contract for the track and overhead work. The track work by Naughton & Company is an excellent piece of work, of standard construction throughout. The overhead construction, including troughing, special terminal work, bracket construction, plaza work, overhead feeders and track return feeders, is of unusually heavy special construction and is also a most creditable piece of work.

At the Manhattan end of the bridge the overhead construction is of special steel lattice girders, supported on steel poles and by attachment to the permanent bridge structure. This superstructure is about 300 feet long and covers the five cross-overs at the Manhattan terminal. It is built of special hardwood oak troughing, to which are attached special bar iron fittings on which the trolley wheel operates. The contact bar is three-eighths inch by two and one-half inches, supported at frequent points by insulated hangers. The frogs and crossings are built up of sheet steel. This construction is necessary because of the large currents required for the handling of the immense number of cars switching at the terminals. The details of this special overhead troughing are shown in Figs. 1 and 2.

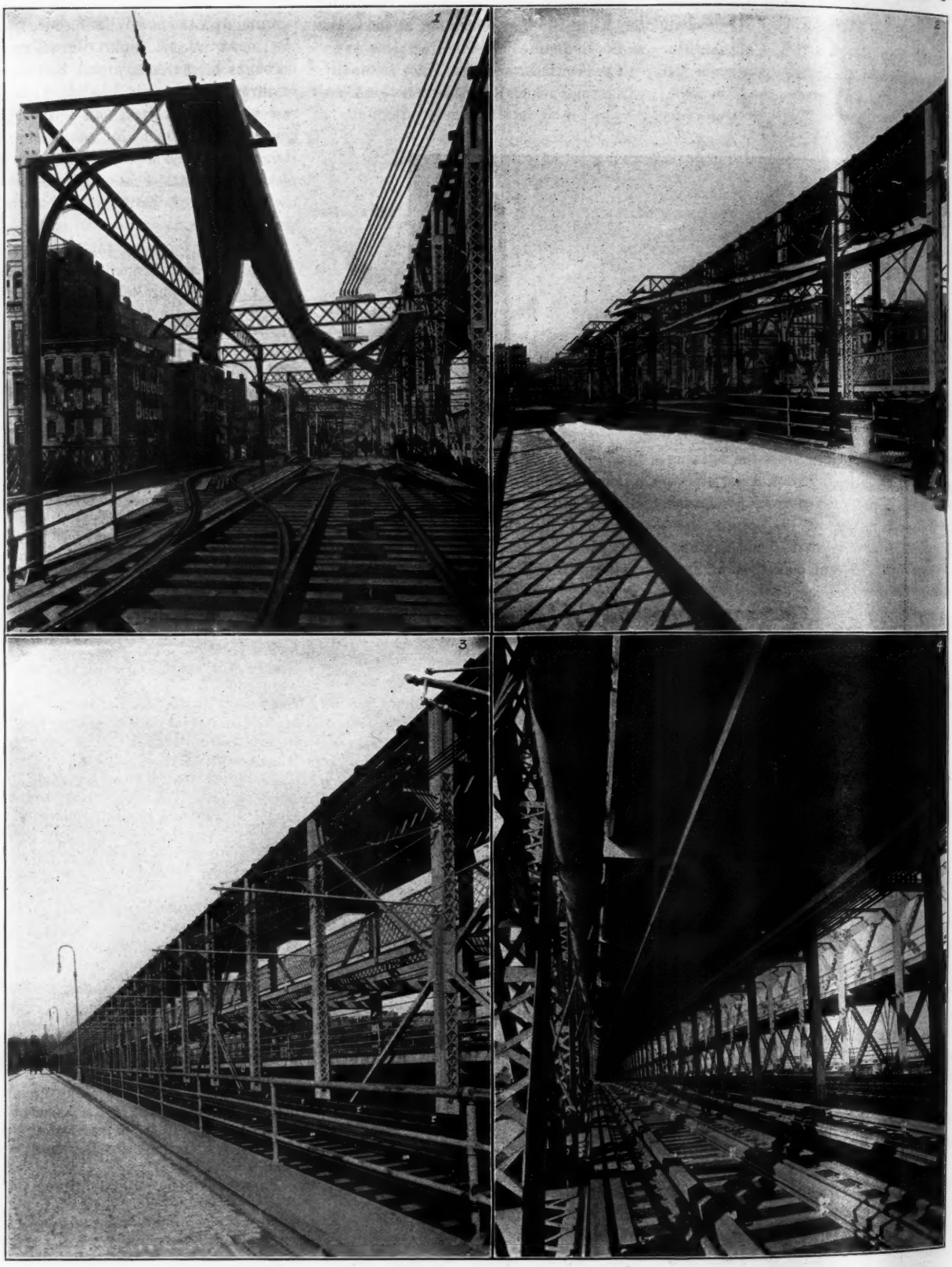
Heavy mast-arms are erected along both approaches to the bridge proper, extending over the double track. These mast-arms are fastened by special fittings to the structural work of the bridge and are provided with two heavy guy rods, with turnbuckles. The two trolley wires are supported to a span-wire along under the bracket. The mast-arms consist of two and one-half inch extra strong pipe, eighteen feet in length. The construction is shown in Fig. 3.

There are about 10,000 lineal feet of single troughing constructed of selected oak and fitted with expansion joints at intervals. The troughing is supported every twenty feet on transverse girders by cleats, and at intermediate points by special hangers attached to cross-beams fastened to the longitudinal girders. The trolley wire is of 3/0 Phono-Electric type, supported every fifteen feet by insulating

hangers. The troughing, as arranged over each track, is shown in Fig. 4.

pansion and contraction amounting to approximately fourteen inches at each joint.

section. This joint is about eight feet in length and is suspended by special hangers



THE NEW WILLIAMSBURG BRIDGE. FIGS. 1 AND 2.—DETAILS OF OVERHEAD TROUGHING. FIG. 3.—THE MAST-ARM CONSTRUCTION. FIG. 4.—TROLLEY WIRE TROUGHING AND FEEDER RETURNS.

At the two anchorages specially designed expansion joints are provided for each trolley wire, in order to allow for the ex-

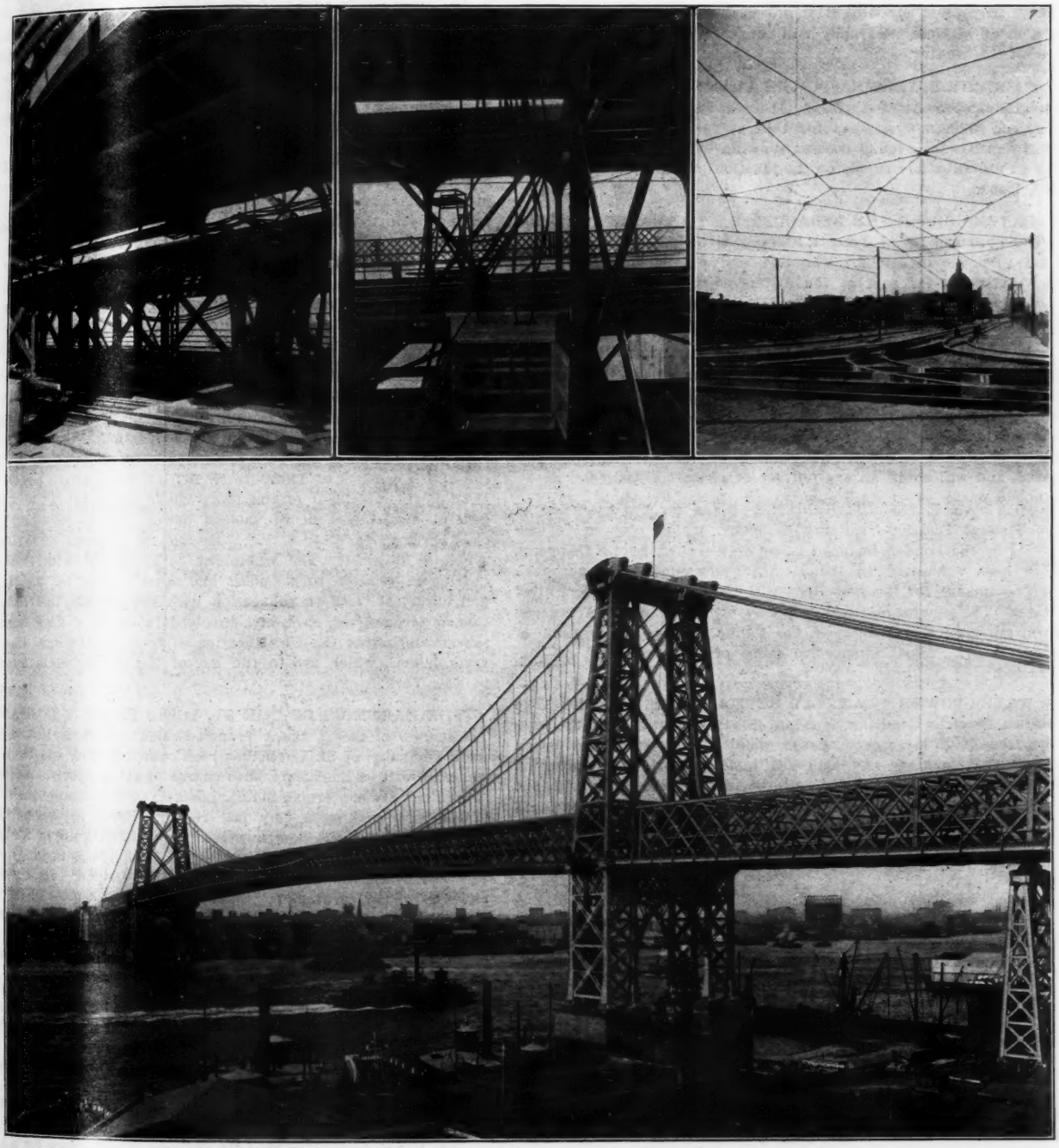
This trolley expansion joint operates very satisfactorily and causes no sparking of the trolley wheel and requires no insulated

from the troughing, which is also designed for similar expansion. This expansion joint is shown in Fig. 5.

There have been erected fifteen miles of 782,000 circular mils stranded weather-proof aluminum cables. Of this about eight miles are overhead for the positive feeders and seven miles are along the tracks for negative returns. The positive feeders are erected on special eight-pin malleable iron cross-arms attached to the bridge structural work over the mast-arms on the approaches, and the cables are supported on malleable iron pins with heavy feeder insulators. Along the bridge, between the towers where troughing was required for the trolley wire, the feeders are supported by heavy oak cross-arms attached to the bridge structural work by wrought-iron clamps.

The negative feeders are erected on heavy porcelain insulators attached by lag bolts to the inside of the six-inch by six-inch guard timbers, there being eight track return feeders, two on each guard timber.

A special steel frame switchhouse has been built on the Brooklyn approach near the bridge tower. This switchhouse is covered with corrugated iron, and from this point the overhead and track return feeders are extended. This switchhouse, with cable connections, is shown in an unfinished condition in Fig. 6. On the Brooklyn plaza heavy steel poles are erected for the support of the overhead work. This work was done in accordance with the Brooklyn Heights Railroad specifications, necessitating special patterns, pull-offs, frogs, etc. Part of the plaza work is shown in Fig. 7.



THE NEW WILLIAMSBURG BRIDGE. FIG. 5.—THE EXPANSION JOINT. FIG. 6.—THE SWITCHHOUSE. FIG. 7.—OVERHEAD WORK AT THE BROOKLYN APPROACH. FIG. 8.—THE BRIDGE FROM BROOKLYN, LOOKING TOWARD MANHATTAN.

This work was constructed for the department of bridges, city of New York, under direction of Mr. Kinsey I. Martin, engineer in charge of Williamsburg bridge, and the work reflects great credit upon the sub-contractors, J. G. White & Company.

CURRENT ELECTRICAL NEWS

DOMESTIC AND EXPORT.

WIRELESS TELEGRAPHY IN CHILI—It is stated that a system of wireless telegraphy will connect Punta Arenas with the rest of the country.

CALUMET & ARIZONA POWER PLANT TO BE DOUBLED—The Calumet & Arizona power plant in Douglas, Ariz., is to be doubled. The new engines for this purpose have been ordered. This step has been found necessary owing to new indications showing an unlimited ore supply on the junction property of the Calumet & Arizona.

EXTENSION OF THE SYRACUSE RAPID TRANSIT SYSTEM—The Syracuse Rapid Transit Railway is to extend its line from East Syracuse to Minoa. The line will parallel the New York Central tracks for part of the distance and will be about three miles long. The company expects to complete the work before Christmas.

ELECTRIC ROAD FOR CHIHUAHUA, MEXICO—It is stated from Chihuahua that a syndicate has been formed and that negotiations have been practically completed for the acquisition of the existing horse lines in Chihuahua and the Mineral railroad. Both of which will be at once converted into electric traction. The contracts for rails, equipment, electric plant, etc., are being prepared, and will entail an expenditure of at least $1,000,000.

MEXICAN ELECTRICAL NOTES—Plans for the extension of the Federal District Tramway Company, which concern is controlled by the London financial house of Wernher, Beit & Company, have been submitted to the Mexican government for approval. The equipment for the new lines will be purchased in the United States. The general manager of the system is Mr. W. W. Wheatley, formerly general manager of the Public Service Corporation of New Jersey. About twenty-five miles of new road will be constructed.

WATER-POWER PLANT AT SEVEN FALLS, QUEBEC—The Quebec Electric Company is about to let contracts for the construction of a large water-power plant at St. Anne and Seven falls. The plans are now approved, and the work of organization arranged. The construction of the dams necessary, and the foundation work in connection with the power-houses at each of the falls will be commenced without delay. Water will be taken from Seven falls at 374 feet. The two falls will develop, at low water, between 22,000 and 25,000 horse-power.

POWER-HOUSE OF THE ROCHESTER, SYRACUSE & EASTERN RAILROAD—The power-house of the Rochester, Syracuse & Eastern Railroad is to be erected at Lyons, N. Y. The power-house with its side tracks, coal sheds, trestles and outbuildings will cover ten acres of land and will give employment to forty men. The machinery will be of 7,500 horse-power and will be furnished by the General Electric Company. The plans and specifications for the power-house call for a building 300 by 187 feet. The building with its equipment will cost upward of $400,000.

ELECTRICITY ON THE NEW HAVEN ROAD—The New York, New Haven & Hartford Railroad Company, it is stated, will begin work soon on its new proposed six-track electric rapid transit system from New Rochelle to Harlem river. The company intends to spend $15,000,000 on improvements. Property has been purchased east of the tracks at New Rochelle, where a $100,000 station will be erected. Three hundred men will be put to work at first in starting the many improvements intended. A corps of engineers, surveyors and contractors who will be in charge of the work have opened offices at New Rochelle.

AUBURN & SYRACUSE ELECTRIC RAILROAD TO DOUBLE-TRACK PART OF ITS SYSTEM—The Auburn & Syracuse Electric Railroad Company has decided to expend $100,000 in double-tracking five miles of its road west of the Syracuse city limits, and in the purchase of new cars and other equipment. The work will be done in connection with the establishment of a park and summer resort on the highlands overlooking the valley and Onondaga lake. The park will be laid out and built by the Edgecliff Park Company, which is to be incorporated with a capital of $50,000. The park company will be controlled by the railroad company, but will be a separate organization.

DOMINION GOVERNMENT TO CONTROL WIRELESS TELEGRAPHY—A suggestion has been received from the British government that Canada should undertake the supervision of wireless telegraphy in the Dominion. It is understood, therefore, that measures will be taken in that country to control wireless telegraphy. There is a clause in the Marconi charter which gives the right to the government to appropriate it in the course of time, and it is undertood that no additional charter will be granted. In time of war, the government could at present have sufficient control over the Marconi charter, so that it is not likely any immediate steps will be taken to buy out the system.

COMMITTEE OF EXPERTS APPOINTED BY PENNSYLVANIA RAILROAD—What is to be known as the Mechanical and Electrical Advisory Committee of the Pennsylvania Railroad Company's New York extension has been appointed by President Cassatt. This committee consists of Theodore N. Ely, chief of motive power; W. H. Baldwin, president of the Long Island Railroad; A. W. Gibbs, general superintendent of motive power; D. S. Newshall, purchasing agent, and A. S. Vogt, mechanical engineer of the Pennsylvania Railroad. The committee is to advise with President Cassatt in relation to all plans and specifications for mechanical and electrical work in connection with the tunnels, power-houses, electric locomotives, cars, etc., involved in the New York terminal scheme, including the electrification of some of the local lines on Long Island, which are to run out of the Pennsylvania terminal in New York.

THE EARNINGS OF THE ST. LOUIS TRANSIT COMPANY—The merger of the St. Louis Transit Company into the United Railways Company, of St. Louis, has been consummated, and the latter company will in the future have charge of the property. As far as it earnings are concerned, the St. Louis Transit Company passes out of existence making a very fair record. From the beginning of the present year the company has made gains both in its gross earnings and service. Last month its total gross earnings were $1,095,842. Its total for the year up to October, amounted to $8,394,143. The earnings for October, 1904, exceed those of October, 1903, by $431,867.55. At the present rate of increase it is believed that the total gross earnings for the year ending December 31 will be at least $10,000,000. The total gross earnings for 1903 were $7,259,460, or $1,134,683 less than the earnings for the first ten months of 1904.

CONSOLIDATION OF WABASH VALLEY COMPANY AND FORT WAYNE & SOUTHERN RAILROAD—The transfer of the securities of the Fort Wayne & Southwestern road to the Wabash Valley company, is complete. The road is now the property of the corporation which owns the interurban line to Logansport, including the city line at Fort Wayne, Wabash and Peru. It also owns the electric lighting plant at Fort Wayne and the franchise for a heating plant. L. O. Williams, formerly superintendent of the Southwestern, is interurban division superintendent of the road from Fort Wayne to Logansport, including the Wabash and Peru city lines, with headquarters at Huntington. E. C. Folsom will be superintendent of transportation and maintenance of way, and stationed at Fort Wayne. C. H. Fansler, master mechanic, is to have charge of the maintenance of all cars, with office in Fort Wayne. M. J. Kehoe, chief engineer and electrician, is to have charge of all power and substations from Fort Wayne to Logansport, with office in Fort Wayne.

PERSONAL MENTION.

MR. HENRY A. JAMES, of Lakewood, N. J., has been elected a director of the Farmington Street Railway, operating a trolley line between Hartford and Farmington, in Connecticut.

MR. ROGER CONANT has been appointed consulting engineer of the Aurora, De Kalb & Rockford Traction Company. Mr. Conant has recently been engaged in traction work in Boston.

DR. LOUIS BELL will give a course of four lectures before the General Electric Engineering Society, Lynn, Mass., during the next few months. The first lecture was delivered at the regular meeting held on Wednesday, November 9. The first three lectures deal with the subject of illumination. The subject for the fourth lecture has not been announced.

MR. W. B. T. BELT has been appointed general superintendent of the Nebraska Telephone Company. Mr. Belt was recently manager of the Omaha branch and has been with the company for fourteen years. Mr. H. P. Ryner, formerly manager of the South Omaha branch, has been promoted to Mr. Belt's position, and Chief Inspector Carter, in turn, is to fill the position left by Mr. Ryner.

MR. F. A. STRATTON, of Mount Vernon, N. Y., has been elected president of the Westchester Lighting Company, of New York. Mr. Stratton has been vice-president of the company for the past six years. In this time he has extended its electric and gas plants to twenty-two cities and towns in Westchester County and the Bronx. The company is capitalized at $22,500,000, and it is said that extensive improvements are contemplated.

CAPTAIN CHARLES DeF. CHANDLER, of the signal corps, U. S. A., has been relieved as transport quartermaster in charge of the United States cableship Burnside by Captain Charles S. Wallace, of the signal corps. Captain Chandler goes to the signal corps post at Fort Myer, Va., and the cableship will go very shortly to the Philippine Islands for regular service. The war department has thirty-five cables in the Philippines, connecting all the important islands and cities.

MR. O. L. REMINGTON, formerly of Brownsville, Ind., but now of Melbourne, Australia, is visiting the United States in behalf of Messrs. William McLean & Company, manufacturers' agents for machinery and supplies. Mr. Remington has now been in Australia during quite a long period of years and the senior member of the firm, Mr. William McLean, is a pioneer in the field of imports in Australia. There probably is no better known firm in their line in Australia than Messrs. McLean & Company. Connections are also maintained in Tasmania and New Zealand and manufacturers desirous of promoting their foreign trade in these countries would do well to communicate with Mr. Remington at Brownsville, Ind., where he makes headquarters while in this country. Mr. Remington leaves for Europe in about two weeks, but will return here about January 1 on his way to Australia.

MR. W. A. NELSON was appointed superintendent of equipment of the Allis-Chalmers Company, October 1, 1904. Immediately after his resignation as assistant superintendent of the Westinghouse Electric and Manufacturing Company became effective, he began work with the Allis-Chalmers Company. Mr. Nelson has had an extended experience and a noteworthy business career in the handling of machine shop propositions. He will have duties in connection with all the works of the Allis-Chalmers Company. Mr. R. C. Wright, who for several years was in charge of the designing of special tools and fixtures used in the manufacture of steam turbines at the East Pittsburg works of the Westinghouse Machine Company, has resigned to accept a similar position at the Milwaukee works of the Allis-Chalmers Company. Mr. Charles F. Barth has recently been appointed foreman of the steam turbine department at the West Allis works of the Allis-Chalmers Company. Mr. C. A. Derby has resigned his position as assistant manager of the Lyon Cypress Lumber Company to join the selling staff of the Allis-Chalmers Company in its saw-mill department. Mr. Derby brings to this new position a valuable and varied experience, having been general manager of the F. B. Dubach Lumber Company, and previously in the engineering department of the Colorado Fuel and Iron Company, at Pueblo, Col.

ELECTRICAL SECURITIES.

Immediately following the election an extremely bullish sentiment gave rise to record dealings in the New York stock market. It is not often that shares reach a 2,000,000 mark, but this was the case on the Wednesday following the election, and even this record was exceeded later in the week. It is worth noting that, notwithstanding the activity of selling, there was sufficient active buying to carry prices to a higher record than has prevailed at any time before this year.

While, in many directions, there is evidence of a growing improvement in industrial conditions, it is in the transportation industry that the most promising revival is apparent. Since July the railroads have been reporting steady and progressive increase in earnings. These reports also show increased economy in operation, which consequently has resulted in larger expansions in the net profits.

ELECTRICAL SECURITIES FOR THE WEEK ENDING NOVEMBER 12.

New York:	*Closing.*
Brooklyn Rapid Transit	67¾
Consolidated Gas	218⅜
General Electric	180¾
Interborough Rapid Transit	155
Kings County Electric	203
Manhattan Elevated	164¼
Metropolitan Street Railway	123⅜
New York & New Jersey Telephone	158½
Westinghouse Manufacturing Company	192

Manhattan Railway directors, at their annual meeting, reelected directors. At a meeting of the directors later in the day officers were reelected.

The Commercial Cable Company is sending to its stockholders notice of a special meeting to be held in New York city on November 22, 1904, to act upon a proposition to alter the company's certificate of incorporation. It is proposed to give the company power to purchase and dispose of the stock and bonds of any foreign or domestic corporation. It is also proposed to give the company power to lease or sell its property and franchise to any telephone corporation, provided such lease, sale or purchase shall have been ratified by a three-fifths vote of the directors and stockholders.

Boston:	*Closing.*
American Telephone and Telegraph	143½
Edison Electric Illuminating	243
Massachusetts Electric	55½
New England Telephone	134
Western Telephone and Telegraph preferred	99

Philadelphia:	*Closing.*
Electric Company of America	10½
Electric Storage Battery common	75
Electric Storage Battery preferred	75
Philadelphia Electric	8¾
Union Traction	58½
United Gas Improvement	106½

Chicago:	*Closing.*
Chicago Telephone	145
Chicago Edison	166
Metropolitan Elevated	67
National Carbon common	40¾
National Carbon preferred	108½
Union Traction common	11
Union Traction preferred	37¼

OBITUARY NOTICE.

MR. WILLIAM A. LAWRENCE, a pioneer electrician of Baltimore, Md., died at his home in that city on Saturday, November 5. He was for many years engaged with the firm of Davis & Watts and invented many appliances in developing the telephone. Mr. Lawrence was probably the first man who actually fitted up electric lights in Baltimore, having installed them for exhibition at one of the Maryland Institute fairs. During the last few years Mr. Lawrence had retired from active work and served as consulting electrician for the Viaduct Manufacturing Company, of which establishment he was for many years superintendent. Mr. Lawrence leaves a widow, who was Miss Mary A. Beadenkopf. His brothers are Rev. Edward A. Lawrence, of Pikesville, and Mr. Millard Lawrence, of Philadelphia; his sister is Mrs. William Gray, of Baltimore.

NEW INCORPORATIONS.

ST. PAUL, MINN.—The H. & W. Telephone Company. $4,995.

COLUMBUS, OHIO—New Lebanon Telephone Company. $10.000.

CLINTON, IOWA—Twin City Telephone Company. $600,000; in Illinois, $30,000.

COLUMBUS, OHIO—Burton Telephone Company. Increased from $15,000 to $25,000.

ELLSWORTH, WIS.—The Pierce County Telephone Company. Increased from $10,000 to $30,000.

SANTA MONICA CAL.—The Telephone and Telegraph Company, of Santa Monica and Ocean Park. $250,000.

JOHNSONVILLE, N. Y.—Johnsonville Telephone Company. $500. Incorporators: J. D. Van Wirt, G. I. Haner, E. H. Abbott, Johnsonville, N. Y.

MILWAUKEE, WIS.—Keelyn Electric Company. $15,000. Incorporators: Peter Keelyn, Benjamin Burdick and Henry S. Schwendener.

LINCOLN, NEB.—Ashland Light, Mill and Power Company. $15,000. Incorporators: Charles H. Brown, Randall K. Brown and J. C. Railsback.

PITTSBURG, PA.—The People's Traction Company. $10,000. Incorporators: C. S. Mitchell, C. J. Braun, Jr., W. B. Carson, J. L. Foster and C. W. Lepper.

BOTKINS, ALA.—Botkins Telephone Company. $20,000. Incorporators: S. H. Mendenhall, Capitola Mendenhall, Charles Eisley, J. Miller and F. Baughman.

WASHINGTON, D. C.—Fox River Electric Railroad Construction Company. $1,250,000. Incorporators: E. W. McCormick, E. M. Freeman and B. E. Kretschmann.

MOBILE, ALA.—Prospect Electric Light and Power Company. $10,000. Incorporators: George Whysall, W. A. Black, J. S. Webb, O. L. Neeresmer and J. W. Petty.

TANNERSVILLE, N. Y.—Schoharie Light and Power Company. $40,000. Directors: C. E. Hewitt and M. G. Hubbard, Chatham, N. J., and H. A. Heyn, New York city.

GUTHRIE, OKLA.—Hobart Light and Power Company. $50,000. Incorporators: Frederick Gale, of Chicago; George Sheldon, of Erie, Pa.; J. H. Carter, of Purcell, and Jacob Sears, of Hobart.

ST. PAUL, MINN.—Mille Lacs & Minneapolis Electric Railway. $150,000. Incorporators: C. S. Kathan, Mora, Minn.; J. N. True, Little Falls; F. P. Quillen, Atkin, and C. H. Warner, St. Paul.

WILTON, ME.—Wilton Electric Light and Power Company. $10,000. President, A. V. Adams, Wilton, Me.; treasurer, C. N. Blanchard, Wilton, Me.; directors, as above named and F. J. Goddard and R. C. Fuller, Wilton, Me.

WILMINGTON, DEL.—Popocatapetl Company, of Jersey City. To engage in gas, electric and steam-heating plants, etc. $5,000,000. Incorporators: D. Henry Lang, Jersey City; Joseph W. Halsey, Passaic, N. J.; Henry L. Van Sykel.

DAVENPORT, IOWA—Iowa City & Davenport Interurban Railroad Company. To construct an electric line between Iowa City and Davenport. $100,000. Incorporators: Milton Remley, C. S. Ranck, Stephen Bradley, George W. Koontz and George E. Remley.

ST. PAUL, MINN.—The Hutchinson & Western Railway Company. To construct a line from Hutchinson through McLeod, Meeker and Kandiyhohi counties. $50,000. Incorporators: E. L. Gregory, W. E. Ellis, Cyrus A. White, E. H. Bass, C. C. White and H. M. Funson, all of Minneapolis.

SAN FRANCISCO, CAL.—Southern Oregon Power Company. $500,000. Directors: Jesse W. Churchill, of Yreka, Cal.; A. J. Rosborough, of Oakland; Frank H. Ray, New York; C. R. Ray, Medford, Ore.; C. S. Denson, San Francisco; H. B. Denson, of San Francisco, and Harvey Yeaman, of San Francisco.

ENGINEERING SOCIETIES.

THE FRANKLIN INSTITUTE—The November number of the Journal of the Franklin Institute contains the following two papers of interest to electrical engineers: "Discussion on the Individual Operation of Machine Tools by Electric Motors," and "A Proposed Modification of the Perfect-Heat Engine Formula," by Louis Illmer, Jr.

WORCESTER POLYTECHNIC INSTITUTE, BRANCH OF A. I. E. E.—A meeting of the Worcester Polytechnic Institute branch of the American Institute of Electrical Engineers was held on the evening of November 11. Professor Harold B. Smith, M. E., chairman of the jury of awards on electric lighting at the St. Louis exposition, gave an illustrated lecture on "Electrical Engineering at the Louisiana Purchase Exposition." The lecture described the electrical exhibits, the work of the jury of awards, the Electrical Congress, and the distribution of current for the illumination and other purposes of the exposition. About sixty persons were present. The next meeting will be held December 9.

WASHINGTON UNIVERSITY BRANCH, A. I. E. E.—The first regular meeting for the current year of the Washington University branch of the American Institute of Electrical Engineers was held on Friday evening, November 11, at the Washington University Club, St. Louis, Mo. Fourteen members were present, thirteen of whom were student members; the attendance was considerably greater than that of last year. It was decided to meet regularly on the first Friday of each month. The programme consisted of the reading and discussion of papers originally presented at the 188th meeting of the Institute in Chicago, and also of one of the papers read at the 190th meeting of the Institute in New York.

ELECTRICAL ENGINEERING SOCIETY OF LEHIGH UNIVERSITY—The Electrical Engineering Society of Lehigh University has prepared an interesting programme of its monthly meetings for the university year. The first meeting took place on October 19. An opening address was made by Mr. Richard H. Smith, and the following papers were contributed: "The Fourth Dimension," Edwin L. Rich, and "The Heating of Magnetic Coils," George S. Merwin. Professor William Esty, head of the electrical department, also made an address. Meetings will be held monthly, as indicated, and the following subjects will be considered: November 17, physics and transmission—"A 20,000-Volt Line at Utica, N. Y.," Clarence H. Eastman; "Electrolysis," Cameron D. Hayes, and "Recent Work in Physics," Dr. William S. Franklin. December 15, electrical equipment of mines—"Application of Electricity to Coal Mining," William H. Grady; "Power Plant in Ore Mine," Harry W. Protzeller; "Electrical Equipment of Pocahontas Coal Mine," Charles E. Kendig. January 19, power—"Power Station at Reading," George H. Shaeffer; "Practical Hints on Power-Station Management," M. A. Maxwell; "Electrical Equipment of Fall River Boat," Chauncy M. Crawford. February 16, electrochemistry—"Electrolytic Refining of Copper," Harry R. Lee; "Electric Energy Consumed in Electrolysis," Dr. Joseph W. Richards; "Some Phenomena Connected with the Use of the Copper Voltameter for Determining H," Barry MacNutt. March 16, telephones—"Insulation Testing of Telephone Lines," Samuel H. Fleming; "Simultaneous Telephony and Telegraphy," W. Raymond Ehlers; "A New Telephone System," Dr. William Whitehorne. April 27, railways—"Monorail System for Electrical High Speed," Thomas B. Mickley; "Single-Phase Railway Motors," Stanley S. Seifert; "Electrical Features of the Rapid Transit Subway," Ernest A. Regestein. The final meeting will be held on May 27, when officers will be elected and there will be certain social functions. The present officers of the society are Richard H. Smith, president; Paul Cloke, vice-president; Earl V. Phelps, secretary; James H. Wiley, treasurer.

TELEPHONE AND TELEGRAPH.

ABILENE, KAN.—A line will be built from this place to Hope in the near future.

GLADWIN, MICH.—The Billings Telephone Company has extended its line to Edenville.

SILVER CREEK, NEB.—The Platte Valley Telephone Company will build in this vicinity soon.

LINCOLN, NEB.—The Archer Independent Telephone Associa-

tion has been incorporated at this place with a capital stock of $50,000.

WATESTOWN, MICH.—The Grand Ledge Telephone Company, of St. John, will build a line to this city soon.

GRAND ISLAND, NEB.—The Nebraska Telephone Company is laying three miles of cable within the city limits.

ELIZABETH CITY, N. C.—The telephone line connecting this city with Weeksville has been placed in operation.

BALTIMORE, MD.—The Manoken Telephone Company is building a line between Princess Anne and Deal's Island.

DAWSON, MINN.—Telephone lines will be built out of this city into Cerro Gordo, Madison, and Lac Qui Parle townships.

EMPORIA, KAN.—A new telephone line is being built between Magda and Plymouth by the Plymouth Farmers' Company.

STERLING, ILL.—The Lee County Telephone Company has placed a contract for a new switchboard equipment to be installed in its new offices.

QUEBEC, QUE.—The Bellechasse Telephone Company is extending its line throughout the county of Lotbiniere, as well as the adjoining counties.

RAKE, IOWA—Another telephone company is preparing to run a line into Rake in the near future. It is to be called the Erdahl Company, and will connect Rake and Frost.

ST. JOHNSVILLE, N. Y.—The long-distance telephone line from the east, which has been in progress of construction for some time, has been connected with the Interstate office here.

MIDDLEBURG, KY.—A telephone line has been erected from Dunnville, this county, to Eunice, Russell County, giving telephone connection with a large area of county heretofore inaccessible.

WILMINGTON, DEL.—The Delmarvia Telephone Company has made application to the street and sewer commission to lay conduits in a number of streets in order to introduce a new metallic system.

UTICA, N. Y.—The subway improvements which have been contemplated for some time by the Central New York Bell Telephone Company have been commenced. The work will require an expenditure of about $50,000.

WATERBURY, CT.—The Southern New England Telephone Company has started the work of excavating for the laying of 30,000 feet of conduits in which to convey the various telephone wires underground.

FOND DU LAC, WIS.—The work of the new switchboard that is being installed in the office of the Wisconsin Telephone Company is being pushed as rapidly as possible, so that everything will be ready for use by the first of the year.

SAN AUGUSTINE, TEX.—The Sabine Valley Telephone Company will soon be established in its new offices in the Hollis Building. The company has a force of men putting in new poles and will install a new switchboard, also improving the system in general in this city.

JACKSONVILLE, FLA.—The independent telephone plant operated in this city by the Jacksonville Telephone Company, and which was established in 1894, has been sold under foreclosure sale to satisfy mortgage, and the exchange discontinued. The purchase was made by D. T. Gerow, trustee, for himself and other creditors.

OAKLAND, CAL.—The Pacific States Telephone and Telegraph Company is putting all its wires in the business portion of the city underground as rapidly as possible. Permits were granted by the board of public works to the company to-day to construct three conduits in the heart of the business district to carry these wires.

DUNKERTON, IOWA—The Blakeville Farmers' Mutual Telephone Company has been incorporated with headquarters at this place and a capital stock of $5,000. A system will be built at once. The officers are: president, C. W. Smith; vice-president, Martin Rinderkeschic; secretary, William Rodgers; treasurer, Sidney Welck.

UNIONTOWN, PA.—The Bruceton & Fairchance Telephone Company has been incorporated in West Virginia with a capital stock of $100,000, and purposes to build a line from Bruceton, W. Va., to connect with the lines of the Tri-State company at Fairchance, Pa. The officers are: J. H. Walls, Brockville, W. Va., president; George B. Irvin, Fairchance, vice-president.

FORT WORTH, TEX.—A telephone merger has been effected whereby the independent exchanges at Brownwood, Goldthwaite, Coleman and Ballinger are brought into the new company. This company also takes in the long-distance line between Lampasas and San Angelo, with several branch lines. Additional long-distance lines are to be put in as soon as possible.

ST. LOUIS, MO.—The Bell Telephone Company has secured a ninety-nine-year lease of the northeast corner of Tenth and Pine streets and has given bond for $100,000 to erect a building within five years to cost from $350,000 to $500,000. The property has a frontage of ninety-seven feet on Pine street and a depth of 109 feet to an alley on Tenth street, and is directly across the alley from the seven-story structure of the Bell company at Tenth and Olive streets. The proposed structure will be from ten to twelve stories in height, of steel frame, fireproof construction, occupying the entire lot, and will probably be connected by means of bridges spanning the alley, with the present structure.

PITTSBURG, PA.—Work is being pushed by the Pittsburg & Allegheny Telephone Company on its line to Wheeling. The line has been completed to Bridgeville. Rapid work is being done also on the Pittsburg & Allegheny's new line to Butler. It seems probable that the entire thirty miles will be completed before Christmas. As on the other Pittsburg & Allegheny long-distance lines, private right of way and a direct route have been obtained. This line will connect the Pittsburg & Allegheny with the independent telephones in northern Pennsylvania, reaching the principal towns, such as Warren, Girard and Titusville. Ultimately it will be a link in the independent route to Buffalo and other New York cities.

NEWARK, N. J.—The New York & New Jersey Telephone Company is planning to erect an uptown telephone exchange at Bloomfield avenue and Rowland street, which will cost $45,000. Plans of the proposed structure have been filed with the building department, and officials of the company say that work will be commenced as soon as possible. The building will be reserved entirely for the use of the company, and it will include offices and a telephone exchange. The structure will be three stories high and forty-six by sixty-two feet in dimensions. It will be of fireproof construction. At the office of the company it was said that plans have not been completed as to what business will be taken care of at the branch exchange.

DES MOINES, IOWA—The Mutual Telephone Company is planning to extend its line along the prairie city road, east of the city, about ten miles from the city limits. Work upon the new line will commence within a short time and will accommodate about 250 farmers in that vicinity. The company is rapidly completing the work of installing the new plant in the building, and it is expected that by January 1 the plant will be in full operation. For a brief time two systems will be owned by this company, inasmuch as it will continue the use of the old plant until the new one is in perfect working order. The connections will be made without inconvenience to the subscribers. It is the intention to use the old plant for country lines.

TROY, N. Y.—The Johnsonville Telephone Company has been incorporated with the secretary of state to build and operate lines as follows: from the village of Johnsonville, Rensselaer County, to the villages of Valley Falls and Schaghticoke; also from Johnsonville through the town of Pittstown to the villages of Melrose, Raymertown, Boyntonville, Potter Hill and to the city of Troy; also from Johnsonville to the villages of Buskork, West Hoosick and through the town of Hoosick; also from Johnsonville through the towns of Easton, White Creek and Cambridge to the villages of Greenwich and Cambridge. The capital stock is $500, and the directors are Jay D. Van Wirt, C. Ira Haner, Ernest H. Abbott, Clarence M. Herrington and Clarence E. Akin, of Johnsonville, and Hiram Sherman and E. D. Herrington, of West Hoosick.

ELECTRIC LIGHTING.

CHAUMONT, N. Y.—An electric light plant may be established here.

JONESBORO, GA.—The new electric light plant has been placed in operation.

SUMMERVILLE, S. C.—An electric light plant has been installed for street lighting.

LINCOLN, NEB.—Work on the new municipal lighting plant will be begun at once.

CRESTON, IOWA—Local men are agitating the installation of an electric light plant.

EATONTON, GA.—The Eatonton electric power plant has been so enlarged as to double its capacity.

DU BOIS, PA.—Falls Creek citizens have formed a company, and propose to install an electric light plant.

ALLIANCE, NEB.—W. D. Rumer has sold his electric plant and franchises to R. J. Lawrence, of Denver, Col.

GREENFIELD, MASS.—The Greenfield Electric Light and Power Company has its power from Gardner falls ready for use.

HOLBROOK, MASS.—It is stated that the Randolph and Holbrook electric lighting system will be extended to Brookville.

LITTLE ROCK, ARK.—The Forest City council has instructed the mayor to ascertain the cost of putting in an electric light plant.

DANVILLE, KY.—Frank T. Snyder, of St. Louis, Mo., has secured a franchise from the city council to erect an electric light and power plant.

DALLAS, TEX.—City Secretary E. T. Winslett will receive bids until December 1, 1904, on an electric light plant with a capacity of from 500 to 1,000 street arc lamps.

LOCKPORT, N. Y.—The town board of Hartland has granted the Niagara, Lockport & Ontario Power Company a franchise to transmit electricity through the town.

WEBSTER, MASS.—The extension of the service of the Webster Electric Company to Oxford, arrangements for which were perfected a few weeks ago, will be begun shortly.

EVANSVILLE, IND.—Bids for lighting the streets of Evansville for five years from August 11, 1905, will be received by the board of public works Saturday, November 26.

CHATTANOOGA, TENN.—The Chattanooga Electric Company has been granted a five-year franchise for street lighting. The city will pay at the rate of $6.49 per month per each light.

NIAGARA FALLS, ONT.—The Electrical Development Company of Ontario, Limited, has awarded contracts, it is said, to the amount of $120,000 in connection with a proposed new power station.

FAIRFIELD, IOWA—The city council has decided to put in, all over the city, new electric lights. It is said that between fifty and 100 will be installed and that they will be put in as soon as possible.

LOS ANGELES, CAL.—The Edison Power Company is signing contracts for work on the Kern river power project the first of the year. The company has just completed power-house No. 2 in Santa Ana Cañon, northeast of this place.

BENTON HARBOR, MICH.—Electric power will be transmitted to this city from the Chapin dam at Buchanan, the wires coming in over the interurban line poles. The power line over a private right of way represents an expense of $100,000.

STAMFORD, N. Y.—It is stated that the Tannersville Electric Light Company will extend its system to Hunter and Tannersville next summer. The company will utilize the water power of Schoharie creek, but will also install a steam plant.

NEW CASTLE, PA.—The council has granted a franchise to the Delaware Water and Improvement Company, of which James M. Seabury, of Philadelphia, is president, permitting it to operate an electric light and power plant for twenty-five years.

SOUTH WINDHAM, ME.—The Mallison Electric Light and Power Company, whose plant is located in this place, has been granted permission to extend its lines on several side streets of South Windham, and work on the same will be commenced at once.

PARIS, ILL.—The City Gas and Electric Company has commenced the erection of a new building, thirty-six by seventy-eight, in which will be installed new dynamos and other electrical machinery. The old electric light system is to be replaced entirely by a new system.

THERMOPOLIS, WYO.—The Thermopolis Electric Light and Power Company has decided to rebuild its plant, which was destroyed by fire a few weeks ago, but will not again endeavor to generate power with water from the hot springs. The new plant will be located higher up the river.

WEST CHESTER, PA.—The plant of the Ridley Creek Electric Supply Company will shortly be ready for operation, as work is being pushed. The power-house is now practically completed and ready for the installing of machinery, which will be of the latest pattern for generating current for light and power.

BOONE, IOWA—At the annual meeting of the Boone Electric Company the following officers were elected: president and manager, John Reynolds; vice-president, C. E. Rice; secretary and superintendent, F. H. Richardson. The company will extend its lines and will install a number of new arc lamps at a cost of $2,000.

LENOX DALE, MASS.—The Washburn Electric Company has been formed with the following officers: president, W. H. Washburn; vice-president, L. H. Hubin; manager, T. E. Moat, of North Adams; directors, the above named officers together with S. O. Tillotson, Frank S. Tillotson, Joseph Cahalin and B. Lawton. The capitalization of the new company is $6,000.

NORTHFIELD, VT.—The Northfield electric power-house, owned by the town, has been destroyed by fire, entailing a loss of $20,000. The fire was caused by a hot box in the engine pit, and as the floors were thoroughly oil-soaked, the flames spread with such rapidity that the fire department found it impossible to save the structure. The insurance on the electrical plant is $10,000.

BANGOR, ME.—The Stanford Mills Company has purchased from B. C. Jordan three mill privileges on Mousam river, and will build a large stone dam just above the town line. This dam will be forty feet high from the river bed, and 250 feet long. From the dam an iron flume six feet in diameter will extend to still water below, giving an eighty-foot head for the operation of an electric power plant.

GUTHRIE, OKLA.—A territorial charter has been granted to the Guthrie Electric Light and Power Company, with a capital stock of $150,000, and with Thos. H. Smith, of Denver, Col.; J. H. Cottingham and U. C. Guss, president of the Guthrie National Bank, as incorporators. This company has purchased all the property of the former electric company here with its plant, franchises and good will, and will at once begin a number of improvements.

JOPLIN, MO.—At a meeting of the new holders of the Southwest Missouri Light Company's stock, arrangements were made to improve the plant of the company at Grand Falls. The stock formerly owned by E. L. Martin and George L. Meyers, of Kansas City, has been purchased by George W. Moore, of New York; David D. Hoag, of Kansas City, and A. M. Barron, of Joplin. Mr. Moore was elected president of the company, Mr. Hoag vice-president and Mr. Barron secretary and treasurer.

OAKLAND, CAL.—A new company, under the name of the Southern Oregon Power Company, has been recently organized under the laws of California, Alexander J. Rosborough, of Oakland, being the secretary. Jesse W. Churchill, of Yreka, is the president of the company, and the capital stock is fixed at $500,000. The company will do business in the Rogue river valley in southern Oregon. The dam and power-house at Gold Roy on Rogue river are finished and the power line is already built to Medford. The company expects to complete the entire project in six months, and anticipates an active market for its output in the mines, lumber districts and for irrigation. It will also light the town of Jacksonville.

ELECTRIC RAILWAYS.

NEW ORLEANS, LA.—It is proposed to build an electric road from this city to the county seat of St. Bernard, twelve miles below.

ROCHESTER, N. Y.—Henrietta and Rush have granted franchises to the promoters of the electric road from Rochester to Elmira.

TOLEDO, OHIO—The city council has passed an ordinance granting the Toledo Railways and Light Company a franchise for twenty-five years.

BELCHERTOWN, MASS.—Plans have been outlined for building a trolley line from South Hadley Center to Ware, through Granby, Belchertown and Enfield.

MANKATO, MINN.—The county board has passed a franchise granting the Mankato Railway, Power and Lighting Company the use of the highways in building its interurban line.

TAMPA, FLA.—John A. Graham, who operates the trolley car lines in Manatee County, has purchased the J. H. Mills franchise for an electric car line through Ybor City and to Sulphur Springs.

POTTSTOWN, PA.—The contract for the grading of the Schuylkill Valley Traction Company's extension from Sanatoga to Pottstown has been awarded, and work will be pushed throughout the winter.

BANGOR, ME.—Considerable activity in electric railroad building is looked for in Maine next year. Among the lines to be built will be one by the Eastern Traction Company between Bangor and Dexter, about thirty-three miles.

CARBONDALE, ILL.—A corps of engineers has begun work on the new electric railroad to connect Jonesboro and Anna. The line will probably connect with an extension of the Coal Belt Electric Railway and at Belleville with lines running from that city into St. Louis.

LOGANSPORT, IND.—Work on the Kokomo, Marion & Western electric road, which will give this city a new connection with Marion, is progressing rapidly. Stone has been placed for the ballasting, a big portion of which will be completed before bad weather causes a suspension of work.

HUDSON, WIS.—At the annual meeting of the Chicago, St. Paul, Minneapolis & Omaha Railway the purchase of the Chippewa Valley & Northwestern and the Eau Claire, Chippewa Falls & Northwestern railways was completed. Both companies were organized by the Omaha for the purpose of building branch lines.

MERIDAN MISS.—The Meridan Light and Railway Company has announced that it will spend about $100,000 at once on improvements of the line. Five hundred tons of new steel seventy-pound rails have been purchased, and the company will take up all the thirty-five, forty and fifty-six-pound rails on the line and replace them with the new rails.

ELIZABETH, N. J.—A resolution giving to the Morris County Traction Company permission to construct a trolley road between this city and Summit has been passed by the board of freeholders. The ordinance stipulates that the road shall be constructed within twenty-two months and that work shall be commenced as soon as the necessary bonds have been filed.

PITTSBURG, PA.—Work on the line of the Jeannette, West Newton & Monongahela Traction Company, between Webster and Greensburg, will begin early next spring. J. S. Cribbs, of West Newton, was elected president, and A. T. Smith, of Jeannette, secretary-treasurer at a recent meeting. The road, twenty-two miles long, will be built on private right of way.

BENTON HARBOR, MICH.—The St. Joseph River Electric Railway Company has deposited $1,000 to guarantee the building of a new road to be completed next summer. The road will connect thousands of acres of fruit lands near this city and will also connect most of the best-known summer resorts along the river. Eventually the line will connect Dowagiac with Lake Michigan.

KALAMAZOO, MICH.—There is a movement on foot toward the organization of another interurban railway company. The new company proposes to connect Kalamazoo with South Haven and also to run lines to Allegan and Grand Rapids. It will be known as the Michigan Interurban Railway Company. The officers are: M. Meek, president; Luke Cooney, Jr., treasurer; and W. L. Barnum, secretary and general manager. All of the officers live in Chicago.

DETROIT, MICH.—The Detroit, Monroe & Toledo Short Line Railway, a trolley line fifty-eight miles long between Detroit and Toledo, is operating through cars over the line. The new road runs hourly cars between the two terminals from 6 A. M. to 9 P. M. and makes the trip in three hours. At Toledo the new line runs a union terminal station and connects with the trolley lines to Cleveland and other Ohio points.

WEST CHESTER, PA.—President Thomas E. O'Connell, of the Oxford, Cochranville & Parkesburg Electric Railway, states that he has concluded the necessary arrangements with a Philadelphia trust company to furnish bonds in the sum of $300,000 to build the proposed trolley line that is to run across the country from Parkesburg to Oxford. All the rights of way have been secured and work on the construction of the line will begin in the near future.

PITTSBURG, PA.—Contracts have been awarded to the New England Construction Company, of New York, for the construction of the Jeannette & West Newton Electric Railroad, which is to be built at once, and run from Jeannette to West Newton. The new line will be fourteen miles long. The contract is taken as a whole and the contractors will not only build the road, but will equip it throughout, including the power-house and cars and barns.

PONTIAC, MICH.—The council, at a special meeting, passed the franchise for the Detroit & Bay City Electric Railway. A provision was added that a rate of one and one-third cents a mile must be made for thirty miles each side of Pontiac. The road will enter the city at the northern limits and practically run parallel with the Detroit, Grand Haven & Milwaukee to the Wesson avenue line, where it will turn to the right and cross the Air Line tracks.

SEDALIA, MO.—The Railway and Electric Company, of Sedalia, passed into new hands and in the future will be known as the Sedalia Transit Company. The purpose of the new organization is to construct and operate an electric lighting and street railway plant. The Sedalia Transit Company has a capital stock of $60,000. The board of directors consists of the following: H. S. Rumsey and Joseph Clark, of St. Louis; W. H. Powell, L. P. Andrews and G. M. Moran, of Sedalia.

CHICAGO, ILL.—E. O. Sessions, chief engineer for the St. Joseph, Albany & Des Moines road, is receiving bids for grading and for materials for the construction of the entire road. The St. Joseph will be operated by steam from St. Joseph, Mo., to Des Moines, and by the third-rail electric system on the divisions between Albany, Mo., and St. Joseph and between Winterest, Iowa, and Des Moines. The construction will include nineteen depots, power and freight houses, machine shops and roundhouses, the entire expenditures being estimated at $8,500,000.

WILKESBARRE, PA.—Announcement is made that the Laurel line will operate the Ontario & Western Railroad to Carbondale as a third-rail road, as the result of the acquisitions of that road by the New York, New Haven & Hartford road. The Laurel line will cross the Lackawanna river in South Scranton, at a point which has not been made public, and run parallel with the tracks of the Jersey Central Railroad until it connects with the Ontario & Western road. A spur will also be built along the Pancoast switch at Dickson City to connect with the Dunmore extension at Throop.

RIDGEFIELD, CT.—It is believed that the New York, New Haven & Hartford Railroad Company is maturing a plan to build a railroad line from Port Chester, N. Y., to Danbury, Ct., along the route of the old Ridgefield & Port Chester road. Overtures have recently been made toward securing options on needed right of way. The original survey between Port Chester and this town was made thirty-four years ago, but construction operations were never undertaken. The building of the line would greatly facilitate the handling of traffic between New York and the Berkshire Hills region.

INDUSTRIAL ITEMS.

MR. G. M. GEST, the expert subway contractor, New York and Cincinnati, has been awarded by the jurors at the Louisiana Fair the highest award for conduit construction.

THE STANDARD STORAGE BATTERY COMPANY, Jersey City, N. J., has been incorporated with a capital of $500,000. The incorporators are Lewis B. Dailey, H. C. Coughlan and B. S. Mantz.

HUGO REISINGER, 11 Broadway, New York city, announces that the international jury of awards of the Louisiana Purchase Exposition has given the grand prize to "Electra" highest grade Nuernberg carbons.

THE INTERNATIONAL CURRENT POWER COMPANY, Buffalo, N. Y., has been incorporated with a capital of $100,000. The directors are Henry Lewis, Edward Delahunt and Thomas MacDonald, Buffalo, N. Y.

THE L. M. ERICSSON TELEPHONE MANUFACTURING COMPANY, Tonawanda, N. Y., has been incorporated at Albany with a capital of $200,000. The directors are Axel Bostrom, Stockholm, Sweden; F. M. Parke and C. H. Smith, of Buffalo, N. Y.

THE COOPER HEWITT ELECTRIC COMPANY, New York city, has been awarded a gold medal for vapor lamps for photoengraving by the Louisiana Purchase Exposition. The company was also awarded the grand prize for the development of mercury vapor arc lamps.

THE ELECTROCHEMICAL COMPANY OF AMERICA, Dover, Del., has been incorporated to engage in the business of manufacturing electrical and scientific chemical products. The incorporators are New York city capitalists, and the capital stock is stated to be $400,000.

THE RENEW LAMP COMPANY, 134 State street, Boston, Mass., is making a special proposition to users of incandescent lamps, in connection with the renewed lamp known as the "Malden" incandescent lamp. This company will be pleased to send information upon request.

THE PEERLESS ELECTRIC COMPANY, Warren, Ohio, is mailing a folder calling attention to the application of the Peerless motors and printing machinery. This folder contains a reprint of a letter from the Curtis Advertising Company, Detroit, Mich., this letter being highly commendatory of the service given by a Peerless motor equipment.

THE GARVIN MACHINE COMPANY, New York city, is calling attention in a neat booklet to a solid extended milling machine knee. There are no openings either in the top or sides, and with a broad front face the knee forms a rigid box calculated to resist the side pressure of heavy cuts and prevent twists and distortion from overhanging work. This booklet will be sent upon request.

THE AMERICAN STEEL AND WIRE COMPANY, Chicago and New York, is distributing a booklet descriptive of the manufacture of sulphate of iron, what it is for, and how to use it. The booklet is well worth securing for the information it contains. The American Steel and Wire Company manufactures wire of every description, wire hoops, electrical wires and cables, telegraph and telephone wire, rail bonds and wire rope.

THE BILLINGS & SPENCER COMPANY, Hartford, Ct., has issued a new edition of its 1904 catalogue. The company is the well-known manufacturer of and dealer in machinists' tools and drop forgings of every description, in copper, bronze, iron and steel. This new catalogue is carefully and accurately indexed, and the price listings are complete. Half-tone illustrations give a good idea of the appearance of the various implements described.

THE ALLIS-CHALMERS COMPANY, Milwaukee, Wis., has published a fine catalogue descriptive of hydraulic turbines and governors. The Allis-Chalmers Company is the sole licensee in North America for the manufacture and sale of turbines, governors and other hydraulic machinery of Escher, Wyss & Company, Zurich, Switzerland. In addition to the descriptive matter and reproductions of turbine tests, there are numerous half-tone and line engravings showing various features of the hydraulic turbines and governors.

THE ELECTRIC CONTROLLER AND SUPPLY COMPANY, Cleveland, Ohio, announces that it has been awarded a gold medal for its St. Louis World's Fair exhibit. The apparatus shown consists of a full line of controllers for crane, charging machines and similar service; a working exhibit of a magnetic switch controller for motors of any horse-power; magnetic friction and stop-brakes; cushion-type solenoid electric-lifting magnets for plates, billets, etc.; resistance banks, knife switches and a working exhibit of the company's direct-connected, variable-speed motor-drive for planers.

THE JOSEPH DIXON CRUCIBLE COMPANY, Jersey City, N. J., is distributing a new catalogue describing the graphite lubricants which it manufactures. The introduction deals with the graphite industry, the theory of lubrication, the characteristics of graphite lubrication, the characteristics of flake graphite in contrast with amorphous graphite, and the practical relation of graphite to the theory of lubrication. The book describes various lubricating graphites and graphite lubricants, including their general use and retail prices of the different sized packages. Copies of this catalogue will be sent upon application to the company.

THE CROCKER-WHEELER COMPANY, Ampere, N. J., is mailing a postal-card souvenir descriptive of the U. S. S. Connecticut. The Connecticut was launched on September 29, 1904, at the Brooklyn Navy Yard, has a length of 450 feet; seventy-six feet eight inches beam; a normal draught of twenty-four feet six inches; a normal displacement of 16,000; an indicated horse-power of 16,500, a speed of eighteen knots, and carries 819 officers and men. The large electric plant with which this battleship is equipped has a capacity of 800 kilowatts, and consists of eight Crocker-Wheeler generators direct-connected to Forbes marine-type engines.

THE AYER & LORD TIE COMPANY, Chicago, Ill., has placed on exhibition at St. Louis, west of the California and South Dakota gold mine exhibits, between the intramural railway stations Nos. 12 and 13, a model plant capable of doing commercial work, showing methods of preserving timber. The timber being treated is placed in air-tight cylinders, where it is first subjected to steam under pressure to remove all air from the pores of the wood. After this the air and steam are exhausted. For producing a vacuum a Deane single-cylinder, horizontal, direct-acting, wet vacuum pump is used. After all the gases and vapor are removed, creosote is pumped into the tank and forced into the wood by pressure.

THE WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY, Pittsburg, Pa., has sold to the Pennsylvania Railroad Company double-motor equipments for 122 cars, with Westinghouse multiple-unit control for these cars and for sixty-one trailers. These equipments will be used by the Pennsylvania company for its Long Island suburban traffic and will be put into operation next spring. The motors will be of the latest Westinghouse type, with a rating of 200-horse-power each. The machinery for the Long Island power plant, now being installed, is supplied by the Westinghouse company and will include three turbo-generators, each having a capacity of 5,000 kilowatts. Westinghouse, Church, Kerr & Company, consulting engineers, are in charge of this installation. The Westinghouse Electric and Manufacturing Company has sold to J. E. Henry & Sons, of Lincoln, N. H., two large induction motors for use in their pulp mill. These motors are of 600 and 300 horse-power, respectively. In addition to these motors twenty-four induction motors and four 350-kilowatt alternators with exciters, switchboards, transformers and other apparatus have been furnished by the Westinghouse company. The company has sold to the Transit Development Company, of Brooklyn, N. Y., a large amount of electrical apparatus, including a complete equipment of transformers, switchboards and rotary converters for ten substations which will be installed by the Brooklyn company on its suburban lines. The order includes thirteen three-phase rotary converters, each of 1,000 kilowatts capacity with direct-current voltage at 550; thirty-three transformers of 400 kilowatts capacity, and twelve of 200 kilowatts capacity. These transformers will be of the air-blast type, taking current at 6,300 volts and delivering it at about 290 volts. The power from the generators of the Brooklyn Heights Railroad Company will be delivered to the substations at 6,300 volts, 3,000 alternations, three-phase. The contract specifies that shipment shall begin February 1, 1905, and shall be completed one year later.